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MALAYAN AGRICULTURAL JOURNAL

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INVESTIGATIONS INTO THE CULTIVATION OF CACAO IN MALAYA. E. F. Allen, B.A., DIP. AGR. SCI. (CAMB.), A.I.C.T.A.

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NOTES ON CURRENT INVESTIGATIONS, APRIL TO JUNE, 1953.

NOTES ON EXTENSION WORK, APRIL TO JUNE, 1953.

DEPARTMENT OF AGRICULTURE, FEDERATION OF MALAYA.

Kuala Lumpur.

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(Continued.)

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THE

Malayan Agricultural Journal

JULY, 1953.

EDITORIAL

Cacao in Malaya. Two of the articles in this issue of the Journal bring readers up-to-date concerning investigations by the Department into the growing of cacao in Malaya.

The first article, by Mr. Allen, supplements the information given in previous issues of the Journal by Hartley and Berwick on trials laid down since Professor Cheesman's visit to Malaya in 1948. It has been established that cacao will grow well on the better soils of Malaya, but that on the poorer soils it requires large quantities of fertiliser. The crop has been established by two methods on virgin soils and both have given good results; on old land, it is now known that establishment of healthy secondary shade prior to planting cacao is essential for success. It is still not possible to give decisions with regard to the intercultivation of cacao with other crops, but experiments to-date indicate that the crop is not likely to be economic when grown under rubber but may be successful when intercultivated with coconuts.

In the second article, Messrs. Rosenquist and Sockalingam record the history to-date of the Amelonado cacao brought to Malaya from the Gold Coast by Mr. Thompson in 1949. This variety comes true to seed and once in bearing can be rapidly multiplied. The Trinitario varieties are, however, of mixed ancestry and do not breed true to seed; it is therefore necessary first to select the best individual Trinitario trees and then to multiply them vegetatively by buddings or cuttings. While selection among the Trinitarios in Malaya is proceeding it has been decided to multiply the Amelonado as quickly as possible with a view to the early establishment of commercial plantations. Initial yields of this variety have proved satisfactory, the pods being uniform and containing good weights of wet cacao. So far, only a small sample of fermented and dried beans has been offered to manufacturers for valuation, but it is thought that Amelonado cacao from Malaya will meet the standard required. It is probable that future selections of the Trinitario variety will prove superior to Amelonado in yield and quality of cacao but it will be several years before supplies of proved planting material become available.

Smallholders' Rubber. In the third article in this issue, Mr. Cook gives a further account of the bulk processing of smallholders' rubber latex.

The general run of smallholders' processed rubber is of a very poor quality, and since 1949 attempts have been made in several localities to encourage smallholders to sell their rubber as latex to large firms for subsequent bulk processing under efficient management, or to form co-operative groups and bulk process their own rubber.

It is encouraging to see that the number of collection-cum-processing centres in operation in 1952 was double the number functioning in 1950, but, as Mr. Cook points out, the quantity of rubber handled at these centres is very small indeed compared to the total production on smallholdings.

High grade rubber that satisfies the buyer earns more money for Malaya, but more important from the smallholder's viewpoint is the fact that he can demand a higher price for properly processed rubber at a time when prices are low and the yield from his trees is decreasing.

Rice Production. The Rice Production Committee appointed by the Government of the Federation of Malaya in November, 1952, published its Report in July. The Report is at present being studied by the Government.

INVESTIGATIONS INTO THE CULTIVATION OF CACAO IN MALAYA

BY

E. F. ALLEN,

Senior Agronomist.

Introduction.

"The potentialities for cocoa cultivation in the Far East are of interest from two distinct though complementary points of view. On the one hand there is already a world shortage of cocoa which is expected to persist for some time and may increase: on the other hand there is a recognized need for diversification of crops in the agricultural development of the territories covered by this survey" (3).

Ever since the publication of the Cheesman Report, from which the above extract is quoted, investigations into cacao cultivation in Malaya have been both widespread and intensive. However, contemporaneous experimental programmes for other crops, with emphasis on wet padi, have also been very ambitious and the depleted staff of the Department have been severely tried in their loyal execution of these experiments. Because of this staff inadequacy the majority of cacao investigations have depended on co-operation with estates whereby the Department has supplied free planting material, experimental designs, technical advice and interim reports, while field supervision and the keeping of growth records have been almost entirely the estate managers' responsibilities. The heavy costs of these trials have been willingly borne by planting companies who have always adopted a most enlightened attitude towards any attempt to diversify Malayan agriculture.

Experimental Methods.

Most agronomic experiments have been planted up with unselected Trinitario seedlings originating from introductions into Malaya from Ceylon prior to 1934. Trinitario cacao gives a very variable seedling progeny and it is now known that this early introduced Trinitario material is also of poor quality and yielding capacity. However, although so variable, it has been of great value for experimental purposes as its availability has made possible an ambitious programme whereby anyone interested in an attempt to grow the crop has been supplied with seed.

To this genetical variability of planting material must be added the many other sources of variation, such as lack of uniformity of sites and soils, differential effects of shade-plants, uneven damage by pests and variation originating from the jungle tree distribution. All this adds up to the fact that, with cacao, conventional experimental procedure cannot always be closely followed (6). The first essential is to make the crop

grow: until this has been achieved it is a waste of time and money to put down over-elaborate field trials. For this reason these co-operative experiments have not always been adequately replicated, although a proportion of those laid down during the last three years have sound statistical designs. It should be placed on record, however, that these fully replicated trials have not always been the most informative ones.

Records that have been kept on the experimental crops include regular measurements of sample girths at 20 cms. above ground level, heights and heights to the first jorquettes. These data are of some value but a better measure of the success of any particular treatment lies in the eye of the observer and it has recently been decided to discontinue the height and height-to-jorquette measurements. The final assessment of a treatment will be based on yields but, since so many trials are only just coming into bearing, and since the first few pods are peculiarly susceptible to pest damage, it is not possible, nor indeed particularly informative, to reproduce here many tables of developmental data.

The Experiments.

The experimental programme is summarised in Table I.

Table I.

Cacao Experiments in Malaya.

	At the end of 1951.		At the end of 1952.	
	Estates.	Agri-cultural Stations.	Estates.	Agri-cultural Stations.
Establishment and spacing trials as a pure crop	24	11	11	4
Variety and progeny trials	3	13	4	12
Spacing trials with mature rubber	4	1	2	—
„ „ „ young rubber	7	—	5	—
„ „ „ coconuts	3	—	3	—
„ „ „ oil palms	2	—	2	—
„ „ „ Manila hemp	1	—	—	—
Manurial trials	2	—	2	—
Total	46	25	29	16

PLATE IX.

Two-year old cacao under shade of thinned jungle, Midlands Estate, Selangor.

PLATE X.

One-year old Amelonado cacao growing under jungle shade.

PLATE XI.

One-year old Trinitario cacao growing under *bĕlukar* shade in Experiment Tr. 11.

PLATE XII.

Cacao planted 5 x 5 ft. under shade of thinned jungle, Jerangau Estate, Trengganu, 10 months after planting.

Unfortunately it is not possible to summarise the various soil types, but the majority of the trials are situated on upland soils of the Kedah * and Batu Anam series, with a smaller number on the Rengam, Segamat and Malacca series (5). A few interesting experiments are on coastal clays of the Selangor series and one on Kuantan series soils.

Establishment and Spacing Experiments as a Pure Crop.

The earlier trials tested spacings ranging from 8 x 8 ft. to 12 x 12 ft. square with a few variations. However, it was soon found that early growth was superior in the closer planted crops, and spacings now being tested include 6 x 12 ft. and 5 x 5 ft., the latter with progressive thinning. It is probable that the optimum spacing for commercial planting will approximate to 8 x 8 ft. but it would be unwise to be dogmatic at this stage.

Different methods of establishment under test are as follows:—

(1) Planting out under established, cultivated shade trees and plants.
(2) Planting out in old secondary forest.
(3) Planting out in virgin jungle which has been judiciously thinned out beforehand.
(4) Planting out under the rapidly growing secondary forest which regenerates when virgin forest is felled but not burnt.

The first method depends on the planting of bananas and mixed leguminous shade trees, with a higher storey of tertiary shade which need not necessarily be leguminous. A ground cover of primary shade plants such as bush-covers, aroids or other food crops may also be used. This method of establishment has proved expensive in practice but it is now evident that it can be simplified and costs reduced by using only reliable and easily propagated species and by eliminating all bush-covers which have been found to be competitive (i.e. *Tephrosia* spp., *Cajanus indicus* and *Crotalaria anagyroides*), expensive to grow and undesirable, in that *Tephrosia* spp. and *Cajanus indicus* often harbour mealy-bugs.

On no estates have bananas proved to be really successful, although they have been found to provide excellent secondary shade on certain Agricultural Stations and they can certainly be recommended for smallholders' use. For estate practice, the planting of *Gliricidia sepium* from cuttings a year before planting out the cacao can be recommended in most localities as this species is easy to grow, once established, stands up well to pruning and is relatively pest-resistent. Unfortunately it is sometimes a little slow to come away and, in this respect, the thornless variety of

* Kedah Series—reddish-yellow sandy loams.
Batu Anam Series—brownish-yellow silty clay loams.
Rengam Series—reddish-yellow, friable sandy clay loams on granite.
Segamat Series—deep, brownish-red friable heavy clay.
Malacca Series—lateritic soils.
Kuantan Series—deep, reddish-brown friable loam over clay loam.
Selangor Series—heavy coastal clays.

Erythrina subumbrans is to be preferred; planting material of this tree is being bulked up rapidly. This thornless Dědap differs from the common species, *E. indica*, in having more oval leaflets, a more upright growth and usually lacking the pair of glands at the base of the terminal leaflet. A more important agricultural difference is that *E. subumbrans* is not fully deciduous and is, therefore, less susceptible to attack by shoot-borers of the genus *Terastia*. It has been used as a very successful pure shade for important budwood nurseries at the Federal Experiment Station, Serdang, but a recent combined attack by Jassids and shoot-borers makes its use in a pure-stand undesirable, even though it is in many ways superior to *Gliricidia*.

Another useful species for secondary shade is the quick-growing, leguminous *Indigofera Teysmanni*, which seeds quite well in Malaya. As it is a recent introduction it has not been tested extensively but it has grown very well on the sandy loams of the Kedah series soils in Selangor.

Lamtoro, or *Leucaena glauca*, which is a favoured species in many other countries, has been found to be very slow to develop in Malaya and it cannot be recommended at present. This comparative lack of vigour is possibly linked with its heavy seed production, so planting material of a sterile hybrid has recently been imported and is slowly being bulked-up vegetatively. This hybrid may be useful if it proves easy to propagate.

For quick shade, tapioca is useful but it is very liable to damage by wild pig and to wind lodging when growing on rich soils. The tree-tapioca, *Manihot dulcis*, can also be useful but it has been very little tested although it grows vigorously in Malaya.

For smallholders, the use of banana secondary shade is to be preferred as this crop will give a useful income, but it should also be interplanted with taller-growing trees as an insurance against damage from wind, pests and Panama disease. Banana trash and chopped up old stems make a first-class mulch for young cacao plants.

A conservative planting plan for cultivated shade, based on a planting distance of 8 x 8 ft., is shown in Figure I. A somewhat wider spacing would be justified when valuable planting material is in short supply, and 10 x 10 ft. should be suitable for such seed gardens.

Cacao grows in nature as a lower-storey tree in the jungle but it cannot be concluded that it requires shade when mature. The functions of tertiary or permanent, high shade will be discussed in a later section. Its value is being tested in field experiments but it will be many years before these yield their answers. Meanwhile it is recommended that mixed tertiary shade should always be planted, if only as an insurance, as trees later found to be unnecessary or undesirable can always be cut out. A mixture is suggested, both to guard against the unexpected failure of certain species and also to avoid sudden shade reduction when a particular tree loses its leaves.

The chief requirements of a tertiary shade tree are considered to be:—

(a) that it should be deep-rooting;

Figure I

CACAO

Planting Plan for Cultivated Shade

Key

Cacao	■ ■	50%
Gliricidia sepium	□ □	24%
Erythrina subumbrans	● ●	12%
Bananas or Indigofera Teysmanni	○ ○	12%
Tertiary shade	▲ ▲	2%

Scale

8 ft.

(b) that it should be of some economic value, yielding either good timber or edible fruits or seed;
(c) that it should be easy to grow and resistent to pests and diseases; and that
(d) a high feathery crown is probably preferable to a lower or heavier canopy.

The first four species to be tested have all now been almost entirely discarded. They were:—

Enterolobium saman	—	the Rain Tree.
Peltophorum pterocarpum	—	the Yellow Flame.
Albizzia falcata	—	the *Batai*.
A. odoratissima	—	the Ceylon Rosewood.

The first is slow when young, branches too low and has a shallow root-system. The *Peltophorum* has a somewhat dense crown and is attacked in plantations by the stem-borer *Zeuzera coffeae*. *Albizzia falcata* has an excellent shape and grows well and quickly on sloping land but it has a short economic life: old trees appear to be susceptible to the root-disease *Ganoderma pseudoferreum*, and its branches break off easily. *A.odoratissima* is slower-growing and satisfactory but it is also attacked by root disease. Species now favoured are:—

Parkia javanica	—	*Petai* or *Kedawong*.
P. speciosa	—	*Petai*.
Peltophorum dasyrachis		
Durio zibethinus	—	Durian.

Other promising species under test include:—

Parkia biglandulosa	—	*Chenering*.
Hymenaea courbaril	—	West Indian Locust.

The two *Dědaps*, *Erythrina subumbrans* and the monsoonal *E.suberosa*, both grow tall enough to be considered tertiary shade trees or they can be pruned down to act as secondary shade.

The *Parkia* spp. have an excellent habit and at least two kinds produce edible and marketable pods. One of these is *P. speciosa* and the other may be a hybrid as it appears to be intermediate between that species and *P.javanica*. These trees, with the durian, are the obvious choice for a smallholder but, like cacao, they benefit from some lateral protection when young.

The second establishment method is the only other one applicable to land which has already been opened up. With this method success depends on the type of *belukar* * which, in turn, reflects both the physical condition and nutrient status of the soil. If the trees are rapidly-growing ones, such as species of *Trema*, *Mallotus*, *Macaranga* and *Sapium*, then it may be assumed that cacao can be planted with a reasonable chance of success. On the other hand, conditions would be less favourable if the secondary forest contains a high proportion of *Melastoma malabathricum* (Straits Rhododendron) and *Eugeissona tristis* (the Bertam Palm), and if *Scleria* sedges, *Lycopodium cernuum* club moss, "lalang" (*Imperata*

* Belukar = Secondary jungle growth.

PLATE V.

Trinitario cacao, three years old, growing between hedges of rubber at Pertang Estate, Negri Sembilan.

PLATE VI.

Amelonado budwood nurseries at the Federal Experiment Station, Serdang. Note shade of *Erythrina subumbrans*.

PLATE VII.

Well-grown seedling Trinitario cacao on Kuantan Series volcanic soil at Jeram Kuantan Estate, under shade of *Albizzia falcata*.

PLATE VIII.

Trinitario cacao with banana shade intercultivated with young coconuts on alluvial clay soil.

cylindrica) and other grasses are present in considerable degree. All these plants in association usually indicate a degraded soil, deficient in organic matter, although individually they may also occur on good soils.

With cacao inter-planted in secondary forest there will inevitably be a certain amount of root competition but this is very much less harmful than a lack of lateral and ground shade. The correct remedy is to manure the crop regularly, preferably with cattle manure or, failing that, with inorganic N.P.K. applied on the soil surface and then covered with mulch.

Where the secondary forest is old and distinguishable from virgin forest only by the absence of tall, emergent trees, then the second method merges with the most interesting third method whereby most of the shrubs and under-storey trees and lianes are cut down and the taller trees thinned out to leave a stand of from 40 to 70 per acre. This use of jungle shade is under test on quite a large scale at Jerangau Estate, Trengganu, and at the nearby Federal Experiment Station, Jerangau. There are also smaller plots at Midlands and Ulu Buloh Estates, Selangor, and a few elsewhere. The similar and older plantings at Serdang are not quite comparable as the shade used there is very old secondary forest. However, it was experience at Serdang which led to the planning of trials elsewhere.

Of all jungle-shade experiments now in progress, Trial TR.11, at Jerangau Estate, is the most informative and this merits detailed consideration. The treatments were:—

I. All trees felled but not burnt. Subsequently the cacao seedlings were planted out in lines in the regenerating secondary forest.

II. Undergrowth slashed and jungle thinned to leave about 70 trees per acre.

III. As in II but some 140 trees per acre left.

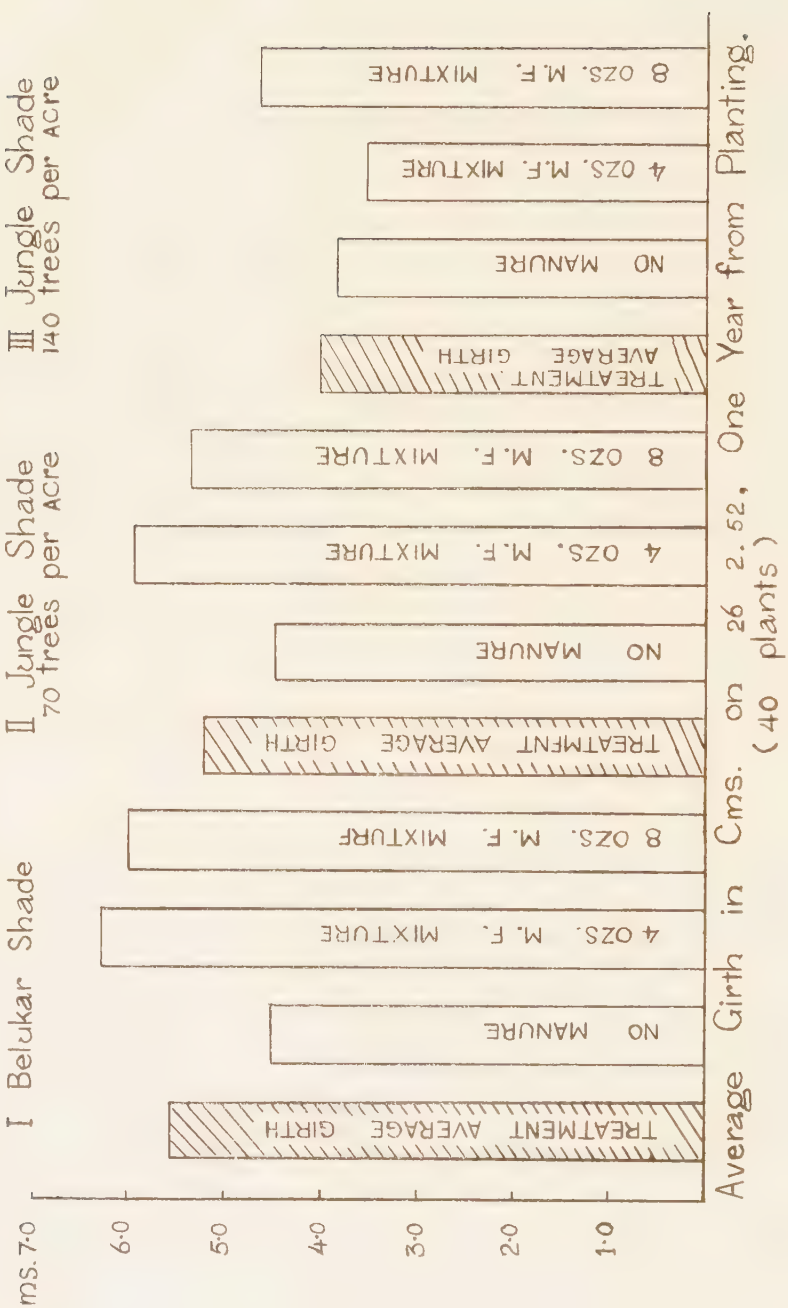
The treatments were unreplicated but each plot covered an area of five acres which was sub-divided into three sub-plots for the following sub-treatments:—

1. No manure in the planting hole.
2. 4 ozs. N.P.K. in planting hole, repeated annually.
3. 8 ozs. N.P.K. in planting hole, repeated annually.

The fertiliser mixture used had a nutrient analysis of 6 : 16.6 : 4.1 per cent. Cacao seedlings were planted out from January to March, 1951, and by the end of the first year it was clear that plants under jungle shade, in Treatment III, had made very little growth; this was confirmed by the girth measurements made in February, 1952, which are illustrated in the block-diagrams in Figure II.

It will be seen that the highest average girth was recorded in Plot I, *bĕlukar* shade, but that there was little to choose between the best trees in this plot and the best in Plot II. It is interesting to note that heavier fertiliser dressings are required to counteract root competition from 140 trees per acre than in the other plots and this difference is

Figure II


CACAO EXPERIMENT TR. II
ESTABLISHMENT EXPERIMENT
I Belukar Shade
II Jungle Shade
70 trees per Acre
III Jungle Shade
140 trees per Acre
Cms. 7·0
6·0
5·0
4·0
3·0
2·0
1·0
Average Girth in Cms. on 26 2.52, One Year from Planting.
(40 plants)
TREATMENT AVERAGE GIRTH
NO MANURE
4 OZS. M. F. MIXTURE
8 OZS. M. F. MIXTURE
TREATMENT AVERAGE GIRTH
NO MANURE
4 OZS. M.F. MIXTURE
8 OZS. M.F. MIXTURE
TREATMENT AVERAGE GIRTH
NO MANURE
4 OZS. M.F. MIXTURE
8 OZS. M.F. MIXTURE

still further accentuated by the measurements taken one year later, which are shown in Figure III.

For security reasons a portion of Sub-plots 1 and 3, in Plot 1, had to be cleared of all tree shade, leaving the young cacao in full sun but with a heavy timber mulch on the ground. It is instructive to note that average girths from both these unshaded portions were identical (12.3 cms.) and of the same order as that recorded from the shaded portion of Sub-plot 3. This indicates that the chief function of the fertiliser dressing derives from a counteraction of root competition.

With regard to the actual jungle thinning it has been found that the more drastic Treatment II was easier in practice than where 140 trees were left. The reason for this apparent anomaly was the greater ease of dealing with lianes when only 70 trees per acre were to be left unfelled.

It should be noted that this establishment method has subsequently been used for other agronomic trials and for a number of seed-gardens. The optimum stand of tall jungle trees appears to vary from 40 to 70 per acre but such figures do not give the full picture as shape and density of canopy is so variable. Large, strangling figs have been found to be too competitive for use as shade but of the very large number of tree species which occur in Malayan jungles the majority appear to be suitable except possibly those with extensive buttress systems.

Growth of cacao in some of the later planted experiments and seed-gardens has been described by the Director of Agriculture as "comparable with if not better than that obtained on good soils of the Gold Coast".

The fourth method of cacao establishment from virgin jungle, namely felling without a burn and the use of the regenerating forest for shade, has given very promising results although it has been less extensively tested than jungle thinning. The species which regenerate are often relatively short-lived and it is not yet certain whether the planting of tertiary shade will be necessary or whether sufficient suitable trees will come in of their own accord. It is now considered that cacao planting in this method should be delayed from 6 to 12 months after felling, so that artificial shade by palm leaves will not be required by the young cacao seedlings.

Variety Trials.

Most of the present cacao variety trials of recent introductions are more the concern of plant breeders than agronomists and they will not be discussed in detail in this paper. However, it is of general interest to list the various introductions that have been made to Malaya under rigid quarantine control:—

West African Amelonado
Indonesian Trinitario
West African Trinitario
Samoan Trinitario

Figure III

CACAO EXPERIMENT TR. II
ESTABLISHMENT EXPERIMENT

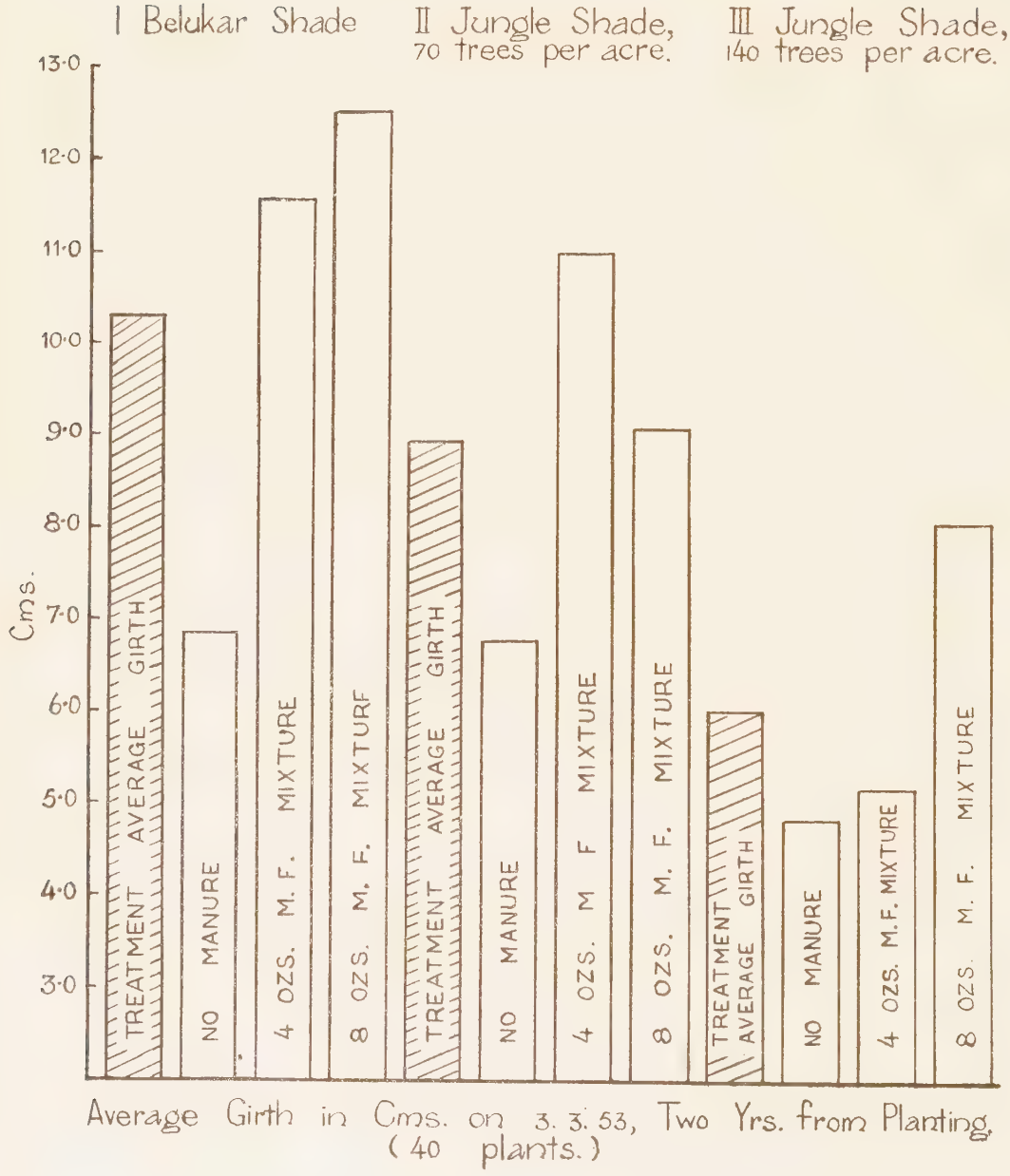
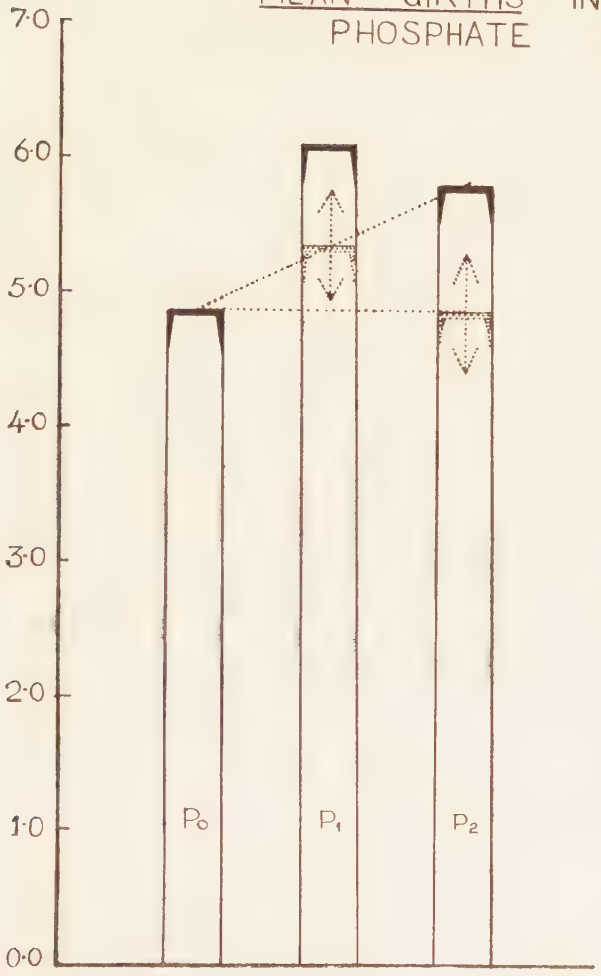


Figure IV

TR. 13 & 14

MEAN GIRTHS IN CENTIMETRES

PHOSPHATE LEVELS



KEY

observed mean girth

expected mean girth with no response to phosphate.

expected variation (S.E. x t at 0·05 probability level.)

Since the observed girths fall outside the expected variation the differences are significant.

New Guinea Trinitario
I.C.S. * seedlings and clones
Upper Amazon progenies.

Only the first need be considered further as all the others will require plant breeders' attention before they can be used for commercial planting. West African Amelonado differs from Malayan Trinitario and Criollo in coming reasonably true from seed, and beans of good quality have already been obtained from seed multiplication crops that have come into bearing. This is the standard cacao from which the bulk of the world's cocoa is produced, and seed-gardens have now been established in ten States and Settlements. When these come into bearing large scale planting on both smallholdings and estates will be possible.

The growth and vigour of West African Amelonado are superior to that of either Criollo or unselected Trinitario and equal or superior to that of early selections. One known disadvantage is that the young shoots are less pubescent than those of most Trinitarios and this characteristic has been associated with an apparently greater susceptibility to attack by the *Helopeltis* bug at one locality, on alluvial clay, in south Perak.

Intercultivation Experiments with Old Rubber.

A number of co-operative trials and several small observation plots on estates have indicated that, under Malayan conditions, cacao cannot economically be established under mature rubber as root competition is excessive. The only apparent exception to this sweeping statement is a 10½ acre block of Criollo cacao, on a Selangor estate, which was planted 22 x 11 ft. under 8-year old Glenshiel I budded rubber. However, when this cacao was planted out, these rubber trees were little larger than average trees 3 to 4 years old, since early growth had been retarded by neglect of drainage during the Japanese occupation.

Intercultivation Experiment with Young Rubber.

This method of establishment has also been tested extensively but results have shown great variation. A number of failures have been clearly associated with inadequate shade for the young cacao plants; other failures resulted from the practice of regular strip or circle-weeding by standard rubber estate methods. This led to repeated set-backs consequent on damage to the surface cacao roots. Nevertheless, certain trials have shown such early promise that it is still necessary to retain an open mind as to the possibility of growing these crops together. At least two of the more successful trials are situated on Malacca series soils containing a very high percentage of laterite concretions. Possibly the mechanism of this early success is that the roots of both crops are restricted by the laterite, thus reducing competition between them. Both theoretical considerations and field observations point to the necessity for frequent applications of manures on such soils and such regular manuring has been found necessary for maintaining yields of rubber.

* Imperial College Selection.

Spacing Trials with Coconuts.

Apart from a narrow coastal strip of sandy soil, from Kelantan south to Pahang, practically all Malayan coconuts are grown on permeable, alluvial clays on the west coast, and it was this latter soil type that was was considered by Cheesman (3) to present unorthodox conditions for cacao cultivation. However, it was soon found that cacao grew well on these rich soils provided that reasonable attention was given to drainage. In consequence, three intercultivation experiments have been laid down and a fourth is planned. In the oldest of these, cacao planted 20 x 20 ft. under old, dwarf palms has shown steady, healthy growth and has come into bearing.

In another trial, in the Bagan Datoh Delta, young, tall coconuts have been planted 30 x 30 ft., 30 x 45 ft. and 48 x 48 ft. with cacao interplanted with banana shade in one, two or three rows spaced 12 x 12 ft. In spite of a somewhat wind-swept situation the best cacao is quite promising and it appears possible that such intercultivation will prove successful on better drained coconut areas. However, nursery work offers many problems on these coastal clay soils since the sub-soil water often becomes slightly brackish during equinoctial spring tides and, if this is used to water basket plants of cacao, fatal results are certain. Similarly, pest control measures require careful attention in the first two years of growth as the incidence of leaf-eating beetles is often high and some root damage has been recorded from *Oryctes rhinoceros* where large quantities of cattle manure were used in planting holes.

On these coastal clay soils the tree *Leucaena glauca* often grows very vigorously on coconut smallholdings and this species is worth consideration as a shade tree for future intercultivation trials.

Intercultivation Experiments with Oil Palms.

Two spacing trials are in progress on alluvial soils and there is a variety trial at the Federal Experiment Station, Serdang, which was planted under 10-year old oil palms on a Kedah series soil. It is a little too early to judge the success of the two trials on alluvium but growth at Serdang has been very poor indeed. Experience has shown that the more the cacao is manured, the more vigorous is the oil palm growth and the greater is the root competition.

Intercultivation Experiments with Manila Hemp.

There are no trials still in progress and old ones have given inconclusive results. However, at Kuala Lipis Agricultural Station, Pahang, situated on volcanic soil, cacao has grown very successfully indeed in association with secondary shade of Manila hemp. It should be emphasized, however, that cacao will grow well on a greater range of soils than will Manila hemp and it is probable that the two crops will only thrive together on virgin volcanic soils.

Manurial Experiments.

Apart from the establishment experiment with manurial treatments, which has already been mentioned, there are only two manurial experiments in progress as it has been the policy to delay laying down such trials until other problems associated with uniform establishment have been solved. These two trials are both co-operative ones on Jerangau Estate, Trengganu, and together they cover 17 acres. They comprise two replications of a 3 x 3 x 3 factorial layout with one replication planted with Trinitario and the other with Criollo cacao. Each plot contains 100 trees planted at 12 x 12 ft.

The manurial mixture used is:—

Fertiliser.	Nutrient Content.	Parts by Weight.
Sulphate of Ammonia	21% N	1½
Christmas Island Rock Phosphate	37% P_2O_5	2
Superphosphate	18% P_2O_5	1
Muriate of Potash	60% K_2O	1

This has a nutrient analysis of 5.7 : 16.7 : 10.9.

The quantities of these fertilisers applied increase progressively up to two years from planting, after which the n_1 p_1 k_1 application amounts to 5½ ozs. per plant every six months or 208 lbs. per acre per annum. Girth measurements taken 14 months after planting have been analysed as one experiment and they revealed a significant response to phosphate, the curvature being negative and also significant. None of the interactions approached significance. These results are shown in the block diagrams in Figure IV.

It may be concluded that, on this particular site, the most economic response of girth increment derives from the single application of phosphate. Unfortunately Criollo casualties were high and this has increased the experimental error.

When the Trinitario figures for height measurements are analysed separately there is also an indication that the double dressing of nitrogen is harmful, the curvature being negative and significant at the 5 per cent. point.

Discussion.

In this survey of cacao trials planted since 1948 it will have been noted that few developmental studies have yielded figures which can be treated statistically. Nevertheless, planters and officers of the Department of Agriculture have gained a great deal of valuable practical knowledge during the execution and supervision of these experiments. True, the paths of investigation have been littered with failures, but there has always been the consolation that such failures have been not less informative than the successes.

It is now known that cacao can be established by two methods on virgin soils and that both give good results. One or other of these

PLATE I.

Amelonado cacao in seed nursery, Degong Agricultural Station, Perak, under secondary shade of bananas.

PLATE II.

Trinitario cacao, 2½ years old, Degong Agricultural Station. Note high level of jorquette due to use of palm-leaf shade around the young seedlings.

PLATE III.

Cacao at the Federal Experiment Station, Serdang. Note secondary shade of bananas and *Gliricidia* with high shade of *Parkia*.

PLATE IV.

Amelonado seedling at Degong Agricultural Station, Perak. Note the use of banana trash as mulch.

methods will be used for extension planting, and a very provisional choice would perhaps favour planting under thinned jungle.

With regard to planting on old land, it is now known that the establishment of healthy secondary shade prior to planting cacao is essential for success. A mixture of quick-growing and easily-propagated leguminous trees offers the best choice of secondary shade for estates, but bananas are to be preferred on good soils for smallholders. In reasonably sheltered areas cacao can be grown without overhead shade, such trees being very bushy when in bearing. However, trees which start off under shade and later become exposed are very susceptible to sun scorch on the main stem with subsequent die-back. It would seem, therefore, that it is only possible to grow cacao commercially without shade when the plants themselves shade their own stems.

Primary or temporary shade plants are usually competitive and most estates will prefer to delay planting until secondary shades have become established. However, smallholders will doubtless make full use of tapioca and other food crops where they can be protected from damage by wild pig.

No evidence has been accumulated in support of the cultivation of tall, tertiary shade trees but their inclusion has much to recommend it, especially if economic species are chosen. Perhaps their chief value is the mulch of falling leaves which make available to the surface-rooting cacao nutrients brought up from subsoil layers beyond the reach of cacao roots (1).

In almost all experiments it has been the experience that well-shaded, young cacao suffers much less from attack by leaf-eating insects than do trees of the same age which are less well-shaded. Since pest-control measures are responsible for a large proportion of the cost of establishment, this advantage of shade is an important one.

It is not yet possible to say on what soil types cacao will succeed, but perhaps the best method of assessing a particular soil's potentialities is to examine the growth of indicator plants, and the banana is the one usually quoted. However, it has been pointed out that bananas do well at higher altitudes than cacao and, in Malaya, they thrive up to 4,700 ft. above sea-level (1,433 m.) (1). The durian is also considered to be a useful indicator crop: where good durians can be grown cacao seems to grow well. It must be admitted, however, that good, early growth has been recorded on some apparently most unsuitable lateritic soils but these have had a good texture and the necessity of regular manuring is well recognized.

With regard to possibilities of intercultivation with other crops, no decision is yet justified. However, it seems clear that the association of coconuts and cacao deserves more attention on suitable, well-drained soils.

The significant result from the two manurial trials is of interest but it does not merit too much emphasis at this stage and it is only applicable to one particular soil type. The best fertiliser is still well-rotted cattle manure.

Summary.

1. Agronomic investigations into the establishment of cacao in Malaya are described in broad outline. Four methods of establishing the crop are described.

2. Where cacao is grown on old land, cultivated shade is considered essential and different types of shade plants are discussed and compared.

3. Two methods of establishing cacao from virgin jungle are described: the use of thinned-out jungle to provide shade has shown great promise and it is at present the preferred method.

4. Mention is made of introduction into Malaya of improved planting material from the world's chief cacao-growing countries. Of these, only West African Amelonado can be used at once for commercial planting: seed gardens of this variety have been established in ten States and Settlements.

5. Intercultivation experiments with rubber, coconuts, oil palms and Manila hemp are discussed. Some trials with young rubber and with old coconuts show promise under certain conditions.

6. Results from two manurial trials are discussed.

Acknowledgements.

The planning and conduct of these cacao investigations and the interpretation of results owe much to ever-helpful advice from Mr. O. J. Voelcker, C.B.E., Director of Agriculture, Federation of Malaya.

Acknowledgements are made to my predecessors in office, Mr. C. W. S. Hartley and Mr. E. J. H. Berwick, and to all field officers for their large share in the conduct of these experiments.

Special acknowledgement is made to all those planters and their assistants for the way such a large proportion of co-operative trials have been successfully carried out, often under conditions of constant danger.

To. Mr. K. D. H. Reader, who lost his life when supervising a cacao experiment, and to Mr. Chuah Eng Chan, who was killed when inspecting an Amelonado seed garden, the country owes a debt which cannot be repaid.

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(2) BERWICK, E. J. H. (1950): "Further Investigations into the Growing of Cocoa in Malaya". *Malayan Agric. J.*, **33**, 194.

(3) CHEESMAN, E. E. (1948): "Report on Potentialities for the Cultivation of Cocoa in Malaya, Sarawak and North Borneo". H.M. Stationery Office, London.

(4) HARTLEY, C. W. S. (1949): "Investigations into the Growing of Cocoa in Malaya." *Malayan Agric. J.*, **32**, 59.

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AMELONADO CACAO IN MALAYA

BY

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Introduction.

On the 19th November, 1949, two hundred cacao pods were harvested from a plot of cacao trees in the Botanic Gardens at Aburi in the Gold Coast. The plot of trees was representative of normal West African Amelonado cacao. An account of the transport of the seed from these 200 pods to Malaya has been given by Thompson (1).

The West African Amelonado variety promises to be as successful in Malaya, within the limitations of our climate, soils, etc., as it has been in West Africa. It is now recommended as the most promising variety for commercial planting in Malaya, and it seems certain that no superior variety or clone will be developed in Malaya for at least five years.

It is proposed therefore to give a brief account of the variety: to record the history of the 1949 importation up to June, 1953, and to summarise the reasons why it is being recommended for commercial planting.

Amelonado Cacao.

Amelonado cacao probably originated in the lower Amazon valley in South America, and was introduced into West Africa in the mid-nineteenth century. A rapid expansion of the cacao industry in West Africa took place during the early years of the present century, and to-day West Africa is the world's greatest producer of cacao, and the entire industry is based on the Amelonado variety.

Amelonado cacao suits the cultivator. It is relatively homozygous and breeds true to seed; thus the cultivator is not forced to adopt vegetative propagation by cuttings or buddings. Amelonado is fairly vigorous, although more vigorous varieties are known, and, being self compatible, it is capable of giving good yields, certain farms in West Africa consistently yielding 1,800 lbs. of dry beans per acre per year. Clones and varieties capable of higher yields are known but there are botanical and economic problems to be solved before they can safely be recommended for commercial planting in Malaya.

Amelonado suits the manufacturer. It is not a 'fine' cacao but forms the 'bulk' with which the manufacturer may or may not blend the

so called 'fine' cacaos. Many manufacturers now use only Amelonado cacao, and once having popularised a particular brand of chocolate they are reluctant to change their standards. Hence there is every indication that the manufacturers will continue to demand large quantities of Amelonado cacao. Although there is a price differential in favour of certain of the 'fine' cacaos the differential is small.

The Distribution of the 1949 Importation within Malaya.

The Amelonado seeds imported by Thompson in November, 1949, were germinated at the isolation station at Pulau Tekong Besar, an island off Singapore. A total of 4,956 seedlings was released for distribution early in 1950, of which the Federation of Malaya received 3,649, the remainder being allocated to North Borneo and Sarawak (1). This quota was divided into the following three groups:—

(i) In round figures, 1,800 seedlings were allocated to a series of eight trials to compare Amelonado with open pollinated seedlings of the local Serdang-Cheras Trinitario (2).

(ii) 300 seedlings were planted in a trial (FESS. 97) to compare Amelonado with legitimate seedlings resulting from crosses between selected Serdang Trinitario parents.

(iii) The remaining 1,500 seedlings were allocated to the seed gardens in Field 44 at the Federal Experiment Station, Serdang. The object of these seed gardens was to multiply the Amelonado variety in suitable isolation.

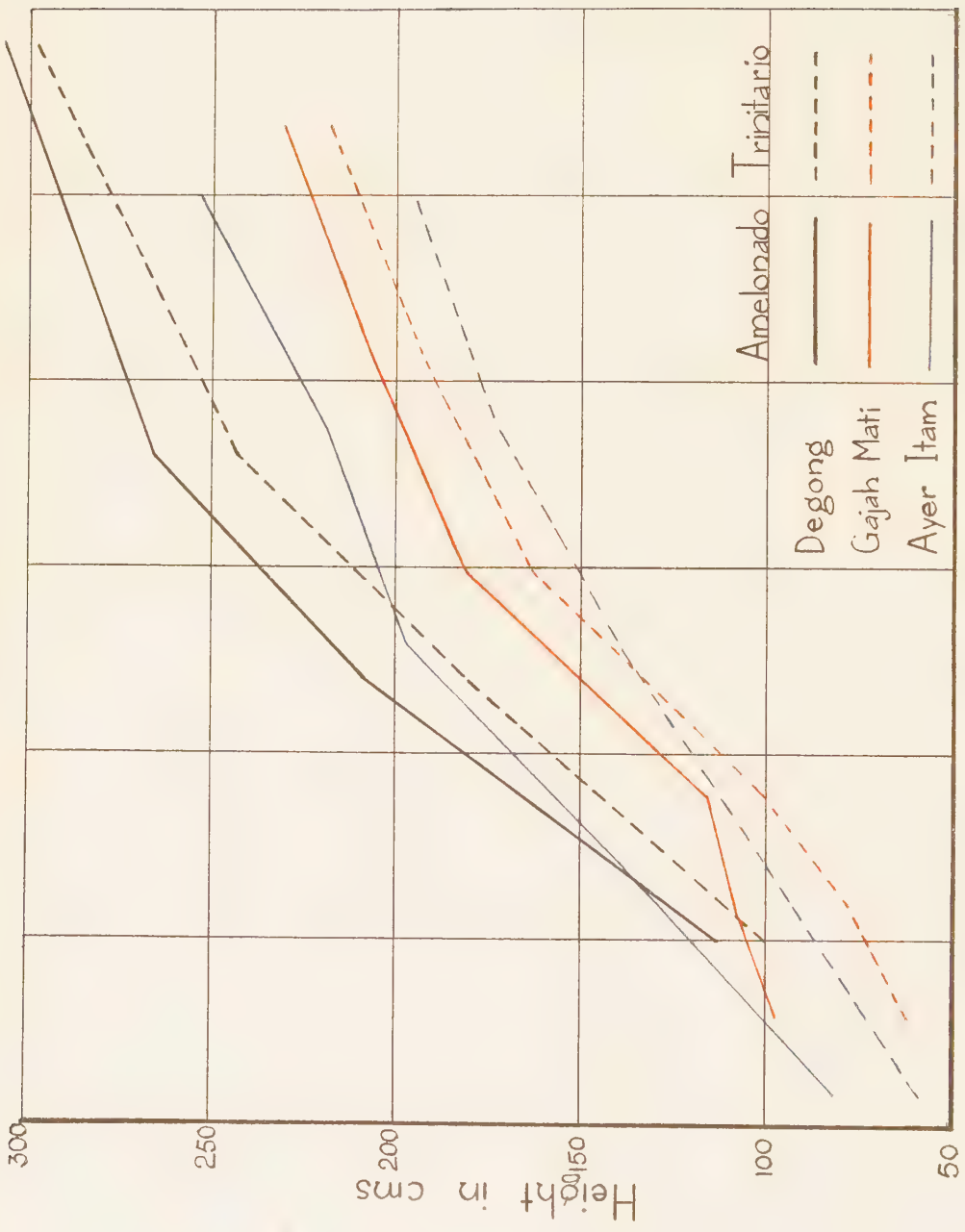
These three groups will be further considered below.

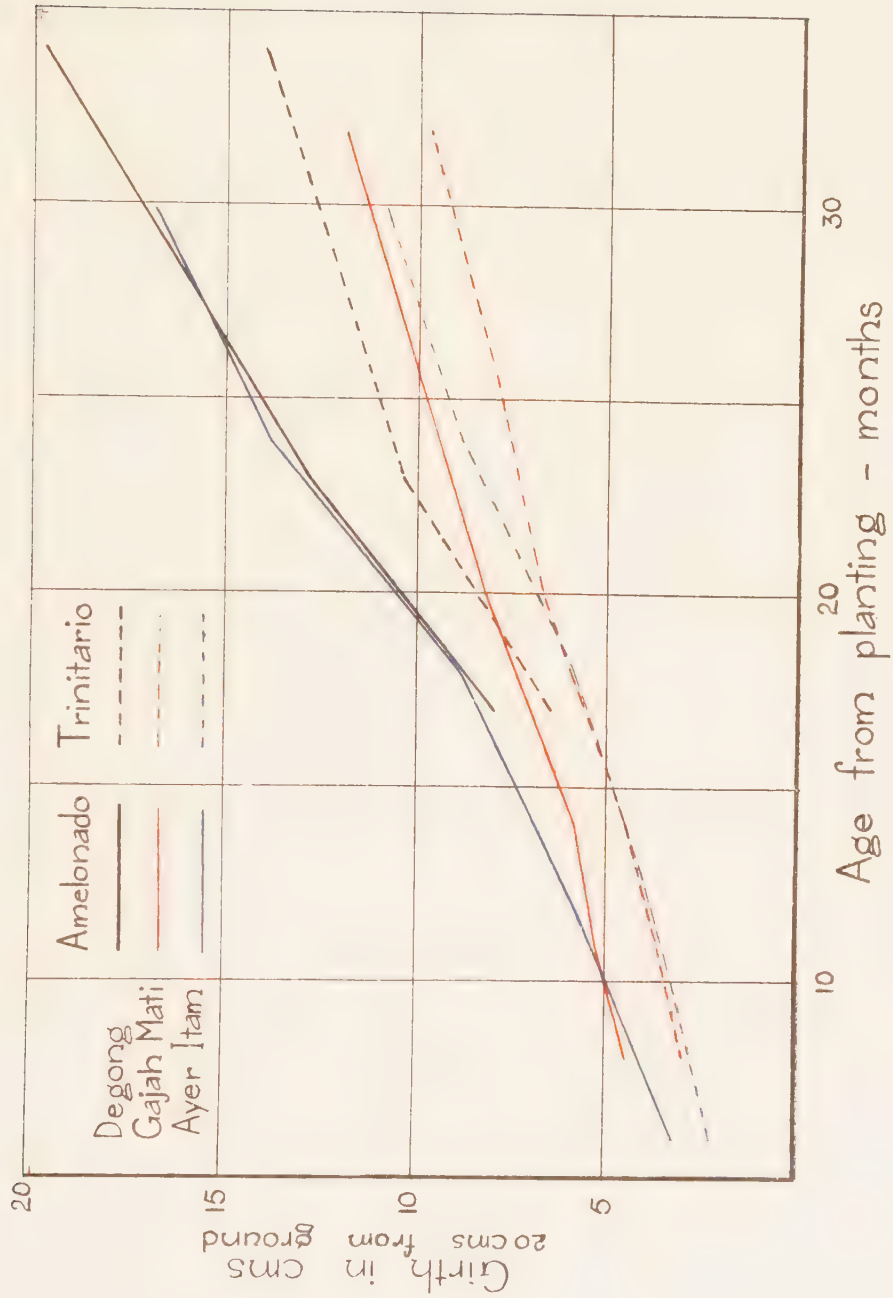
The Amelonado Versus Open Pollinated Trinitario Trials.

The eight trials to compare Amelonado with open pollinated Trinitario were distributed throughout Malaya from Kedah, in the North, to Johore in the South. In the spring of 1950, when these trials were planted, cacao was a new crop in Malaya and the soil and other conditions required to establish cacao were not fully understood. Consequently, of the eight trials four have subsequently been abandoned as failures. Some data from the three more successful trials are given in the graphs on pages 166 and 167.

In each case Amelonado cacao has proved to be more vigorous than the local Trinitario. The height and girth measurements of Amelonado have in all instances been greater than the equivalent figures for local Trinitario. In many cases the superiority of the Amelonado was statistically significant.

This conclusion is of some importance when considering the agronomic trials described by Hartley (3), Berwick (4) and Allen (5), as every one of these trials was, of necessity, based on open pollinated local Trinitario seedlings. There is little doubt that where Trinitario has been successfully established Amelonado would have proved even better. It is also possible that in some instances where Trinitario failed Amelonado may have succeeded.


Height in cms
300
250
200
150
100
50
10
20
30
Age from planting - months
Degong
Gajah Mati
Ayer Itam
Amelonado
Trinitario


Girth in cms
20 cms from ground
20
15
10
5
10
20
30
Age from planting - months
Degong
Gajah Mati
Ayer Itam
Amelonado
Trinitario

The Amelonado Versus Legitimate Trinitario Trial.

This trial (FESS. 97) was planted at the Federal Experiment Station, Serdang, in April, 1950. The Trinitario parents included some of the best of the original (1934) Serdang Trinitario trees. One parent, S.15, was clearly superior to the others in a number of characters, although it has proved most difficult to propagate as a clone. The progenies of this parent as well as the progenies of two other Serdang selections, S.27 and S.47, were included in the trial. As all the primary selections were self-incompatible, three other selections, S.21, S.43 and S.68, were employed as male parents. Thus the experiment contains the following three groups of progenies:—

A—Amelonado seedlings (open pollinated from Aburi).

B—S.15 x S.43 and S.15 x S.68 seedling progenies.

C—S.27 x S.21, S.27 x S.43 and S.27 x S.68, and S.47 x S.21 and S.47 x S.43 seedling progenies.

For simplicity these will be referred to as Amelonado, Trinitario B and Trinitario C respectively. The experiment is of the randomised block design with seven blocks and 30 trees per plot.

Vegetative Vigour.

Height and girth measurements were taken at six-monthly intervals. Trinitario B has proved to be the most vigorous, with Amelonado second and Trinitario C a poor third. The differences in height and girth were statistically significant, e.g. at 12 and 18 months all differences were significant at the 1 per cent. level of probability. The heights and girths at various ages have been plotted on the graphs on pages 169 and 170.

In this trial, the progeny of one particular Trinitario tree, S.15, has been shown to be more vigorous than Amelonado; thus it cannot be said that Amelonado is more vigorous than Trinitario without qualification. If suitable Trinitario parents can be found, their progenies may be more vigorous than Amelonado.

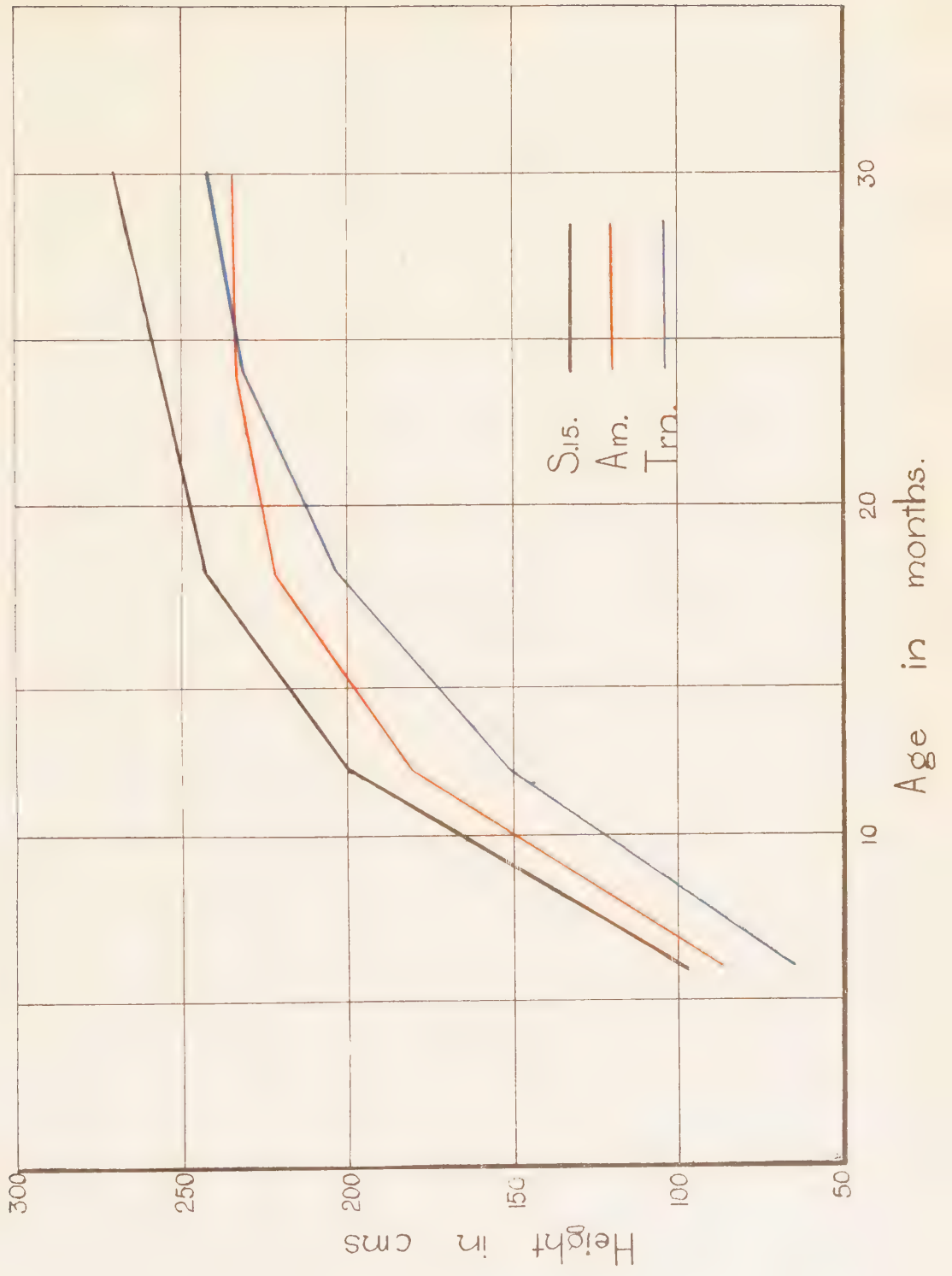
Yields.

Only some 500 pods have been harvested from this trial so far and no conclusions about the relative yields of the three varieties can yet be made. There is no suggestion that Amelonado is inferior to Trinitario in yield of pods—in fact Amelonado is at present in the lead.

Pod Analyses.

All the pods harvested from this trial have been opened and the good beans (wet cacao) counted and weighed. The data obtained up to the 1st July, 1953, are summarised in Table I.

The average weight of wet cacao per pod was greatest in the Amelonado, with Trinitario B slightly less. Trinitario C is very poor but typical of the Serdang-Cheras (1934) Trinitario. When the number of beans per pod is considered, Amelonado is clearly far superior to either of the Trinitarios.


Height in cms
300
250
200
150
100
50
10
20
30
Age in months.
S.I.S.
Am.
Trn.

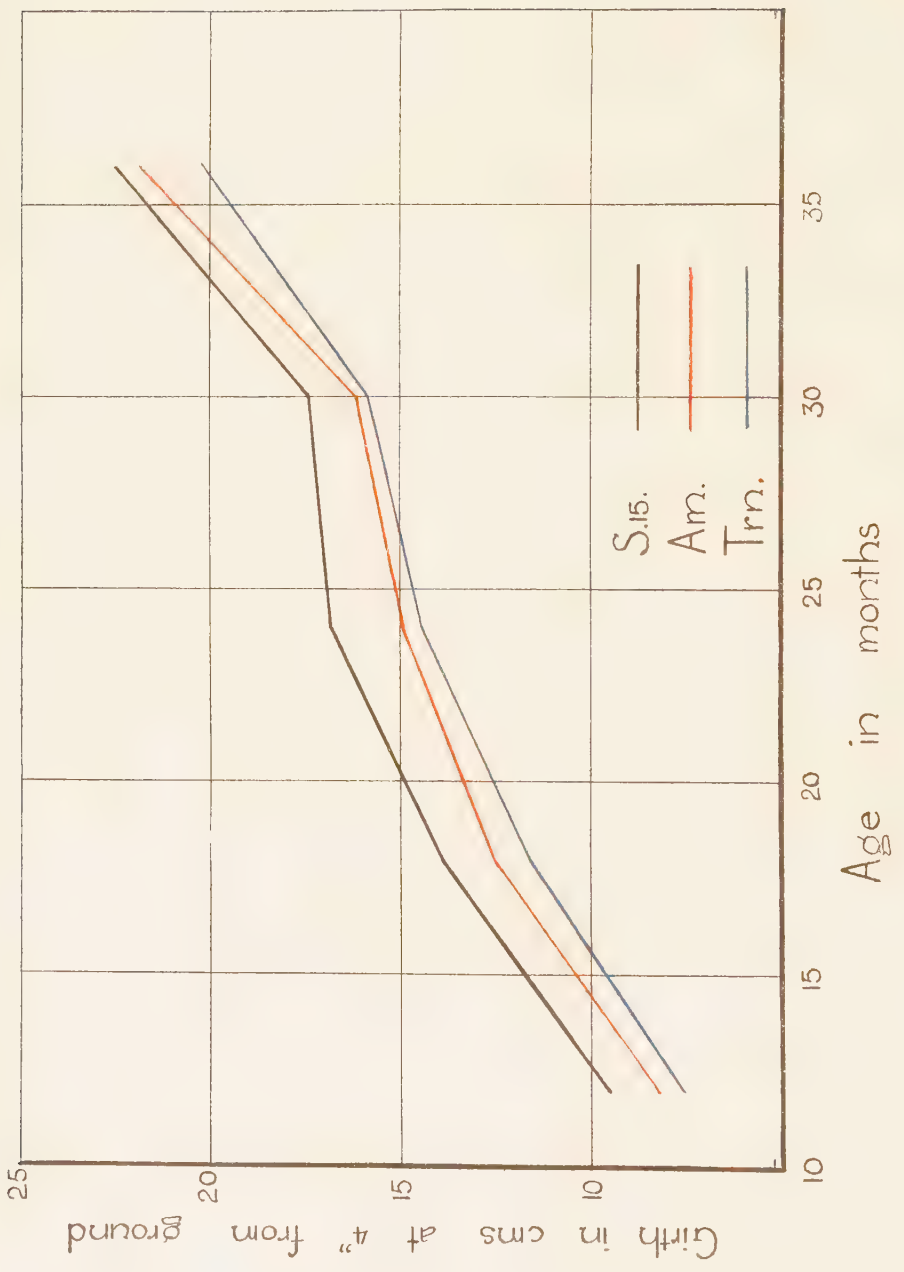

Girth in cms at 4" from ground
25
20
15
10
10
15
20
25
30
35
Age in months
S.15.
Am.
Trn.

Table I.

Data from Experiment FESS. 97 up to the 1st July, 1953.

	Variety.		
	Amel.	Tr.B	Tr.C
General Data.			
Yield of pods from 210 trees	202	121	182
Mean weight of wet cacao per pod (gms.)	111.9	102.1	58.5
Mean number of beans per pod	40.0	26.9	19.4
Estimated yield of wet cacao (kgs.)	22.6	12.3	10.6
Pod Data.			
Mean weight of wet cacao per pod (gms.)	111.9	102.1	58.5
Median value of wet cacao per pod	114.3	105.6	54.8
Coefficient of variation (per cent.) wet cacao per pod	20.4	44.3	52.4

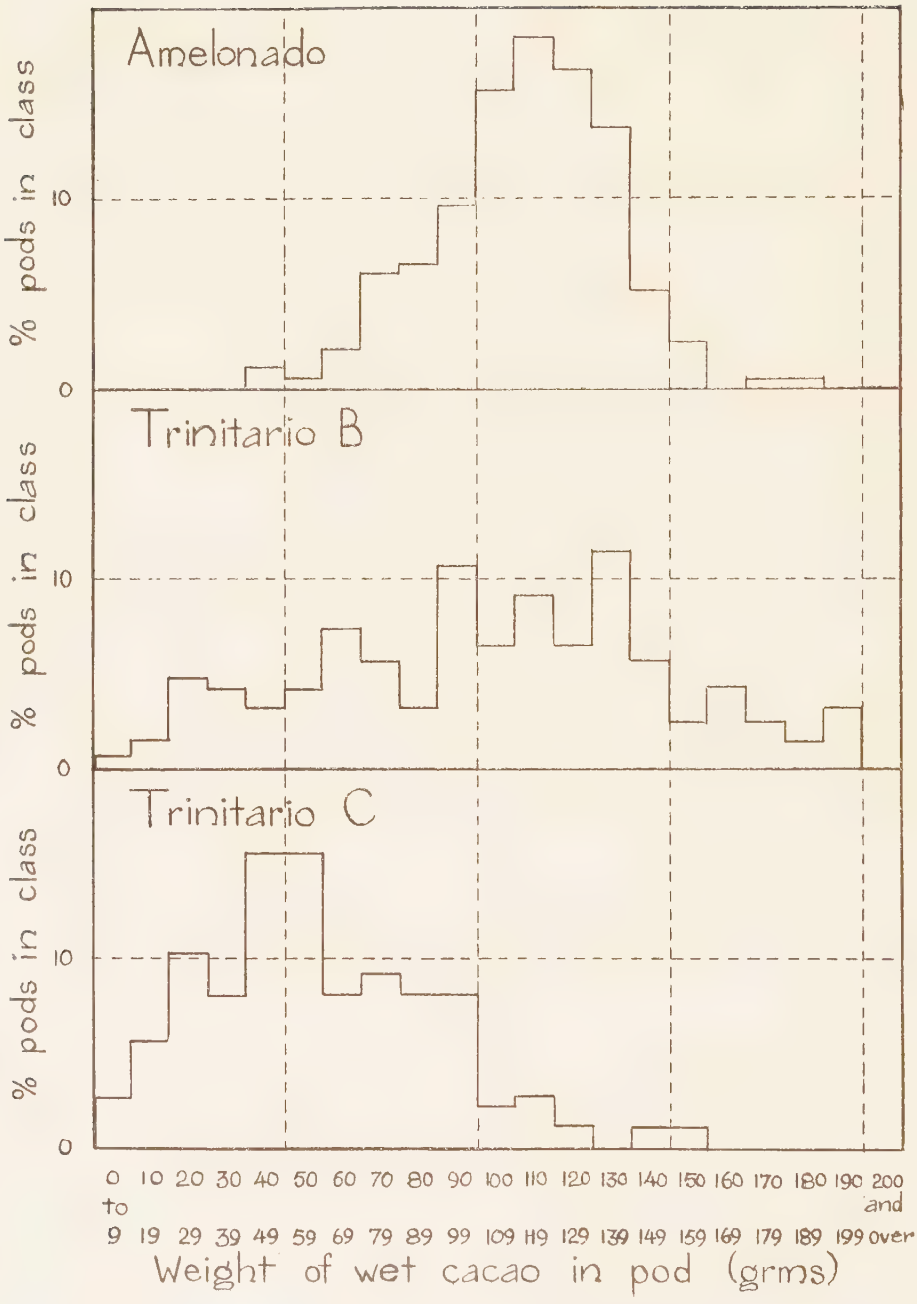
In the histograms on page 172 the pods from each variety have been grouped into 18 classes according to the weight of wet cacao per pod. In the Amelonado variety, 65 per cent. of the pods fall into the classes containing from 100 to 139 grammes of wet cacao, and only 8.7 per cent. of the pods had over 139 grammes. In Trinitario B, on the other hand, only 33.8 per cent. of the pods fell into the 100 to 139 gramme classes but 19.8 per cent. of the pods contained over 139 grammes of wet cacao. Clearly the Amelonado pods are more uniform than the Trinitario.

Another way of presenting the data is to consider pods containing over 139 grammes of wet cacao as above average, pods with 100 to 139 grammes as average, and pods with less than 100 grammes as below average. Table II can then be constructed.

Table II.

Classification of Pods by Wet Cacao Content.

	Variety.		
	Amel.	Tr.B	Tr.C
Pods above average (per cent.). .... (139 + gms. wet cacao)	8.7	19.8	2.3
Pods average. (per cent.). .... (100 to 139 gms. wet cacao)	65.2	33.9	6.3
Pods below average (per cent.). .... (100 − grms. wet cacao)	26.1	46.3	91.4


Amelonado
Trinitario B
Trinitario C
% pods in class
0
10
0 to 9
10 19
20 29
30 39
40 49
50 59
60 69
70 79
80 89
90 99
100 109
110 119
120 129
130 139
140 149
150 159
160 169
170 179
180 189
190 199
200 and over
Weight of wet cacao in pod (grms)

This uniformity of Amelonado is characteristic. Few Trinitario strains or progenies produce pods of such uniformity.

In a similar way, Amelonado pods always contain about 42 beans. In this trial 62 per cent. of the Amelonado pods have contained between 40 and 48 beans. The Trinitario pods have contained less beans and the number has been far more variable; this is illustrated by the histograms on page 174.

Dry Bean Size.

A few Amelonado pods harvested from this trial have been used for fermentation trials. In one trial in March, 1952, when the Amelonado plants were only 28 months old, a comparison was made between Amelonado and mature trees of local Trinitario. The beans from nine Amelonado pods were kept separate in muslin bags and then fermented in a bulk of Trinitario beans in a basket. The results obtained are shown in Table III.

Table III.

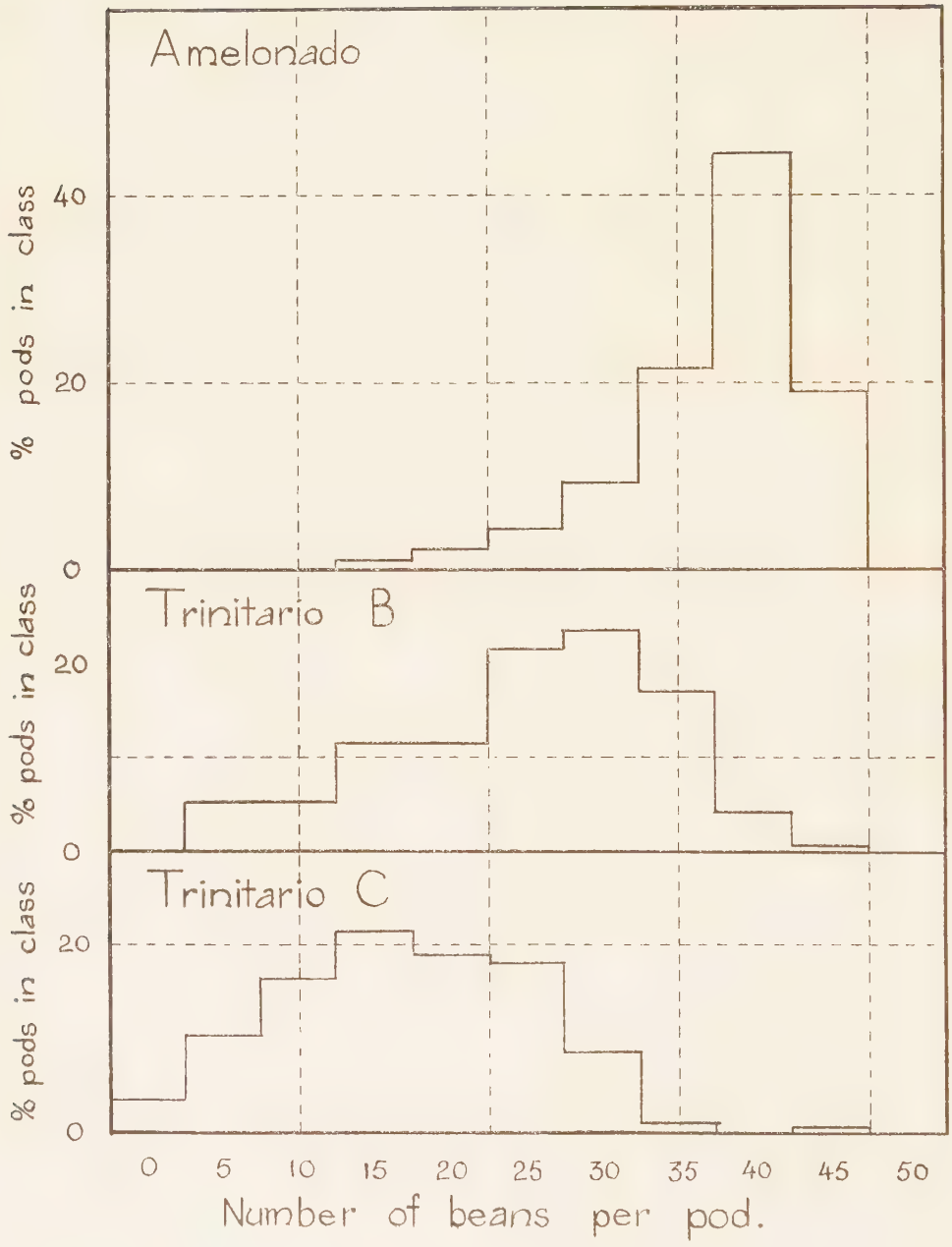
Fermentation Results.

	1934 Trinitario.	Amelonado.
Recovery of dry fermented beans from wet (per cent.).	25.5	36.2
Mean weight of one bean (grms.).	0.77	0.82
Pod value (pods to produce 1 lb. of dry cacao).	29.6	15.4

The local Serdang-Cheras (1934) Trinitario has consistently given recovery percentages of about 25 to 30 whereas the figure should be about 40. As can be seen, Amelonado at 36.2 per cent. approached the expected value even though the trees were so young.

During 1953 the beans from Amelonado pods were again kept separate on several occasions by placing them in muslin bags and fermenting in a bulk of Trinitario. On another occasion, 129 Amelonado pods were opened and the beans fermented in a basket. The average figures obtained from these trials in 1953 were as follows:—recovery of the dry cacao from wet, 39 per cent.; weight of one dry bean averaged 1.10 grms.; the pod values ranged from 11 to 12. These figures are considered satisfactory.

The manufacturer attaches considerable importance to bean size because small beans are associated with a high proportion of testa, which is a waste product. A low percentage of cacao butter is also recognised by the trade as another unfavourable accompanying characteristic. A minimum standard is 1 gramme per bean. The local Serdang-Cheras


Amelonado
Trinitario B
Trinitario C
% pods in class
40
20
0
0 5 10 15 20 25 30 35 40 45 50
Number of beans per pod.

(1934) Trinitario beans do not reach this minimum standard, but the Amelonado pods now being harvested give dry beans which exceed the minimum size standard.

There is therefore every prospect that fermented and dried beans of Amelonado cacao produced in Malaya will be commercially acceptable. A first, small sample has been submitted to a manufacturer.

The Seed Gardens.

In order to ensure a supply of Amelonado seed, 1,500 seedlings, which were released from the isolation station at Pulau Tekong Besar, were planted at the Federal Experiment Station, Serdang, in Field No. 44. The soil in this field is a yellow, silty clay loam of the Kedah series (6) which is a soil type considered not particularly suitable for cacao.

The field is divided into two parts, 44a and 44c. Field 44a is in the bottom of a valley and covers about three acres; in 1949 the field was carrying a poor crop of Manila hemp. Field 44c is on the southern bank of the valley and was under secondary jungle about 20 years old. A few notes on the establishment of cacao in these two fields are given below.

Establishment of Cacao in Field 44a.

The land was cleared and cultivated mechanically, and Manila hemp planted 24 x 12 ft. in February, 1950, as shade for the cacao. Planting holes for the cacao (12 x 12 ft.) were dug with a Danuser digger 18 ins. in diameter attached to a Farmall H. tractor, and 5 lbs. of old bat guano and 3 lbs. of a mixed fertiliser were incorporated in the holes. The four-month old cacao seedlings were planted on mounds about 8 ins. high in March, 1950. The bottoms of the baskets containing the seedlings were cut out before planting. A mulch of about 40 lbs. of compost was then given to each seedling.

As the Manila hemp was providing no shade for the cacao, a ring of about 30 *Bertam* palm (*Eugeissiona tristis*) fronds was erected round each seedling to provide artificial shade. It soon became clear that the cacao was going to grow out of this palm frond shade before the Manila hemp gave any useful shade, and so the following extra shade species were planted—*Gliricidia sepium* (= *G.maculata*) (24 x 12 ft.), *Adenanthera pavonina, Peltophorom pterocarpum* (=*P.ferrugineum*) and *Erythrina subumbrans* in a mixed stand at 36 x 36 ft., as well as bananas (mainly *Pisang Awak*) as a hedge in every seventh row of cacao.

During 1950 the cacao grew fairly well in the artificial shade; in 1951 the cacao was so tall that artificial shading was impossible (Plate I), and, as a result, the plants were scorched by the sun and young flushes of leaves were burned off before they could harden. Numerous axillary shoots were produced on the branches which were in turn defoliated (Plate V). Some plants produced new shoots from the base, which were again protected by artificial shade and allowed to grow.

During 1952 the shade conditions improved as the *Gliricidia*, *Erythrina* and Manila hemp etc. began to give some shade. By the end of the year, conditions in most of the area were considered satisfactory (Plate II). The cacao trees although badly shaped are now quite healthy and vigorous.

Pest control has required constant attention. After the first year, when the palm fronds were not replaced, leaf eaters were the main worry, the species concerned being the night flying beetles (*Apogonia cribricollis* and *Chactadoretus cribratus*) and grass-hoppers (*Valanga catantops* and *Catantops humilis*). During late 1952 and early 1953 the mosquito bug (*Helopeltis theobromae*) attacked the pods and young shoots. More recently borers (*Zeuzera coffeae*) in the main trunk and branches have caused considerable damage. Mealy bugs (*Pseudococcus citri* and *Ferrisia virgata*) have also caused damage. Control measures have varied, but at present the following sprays are being used:—against leaf eaters, lead arsenate at 0.4 per cent. sprayed on the young leaves at fortnightly or monthly intervals depending on the level of the attack; against Helopeltis, Accotox at 0.2 per cent. sprayed on the whole plant and under the pods and cherelles where the bugs usually hide; against mealy bugs, Albolineum at 1 part in 60 parts of water. Stem borers are being controlled by injecting o-dichlorobenzene into the holes and plugging them with plasticine.

Applications of fertiliser have been generous. A mixture of one part sulphate of ammonia, two parts rock phosphate, one part muriate of potash, and four parts Sterameal, by weight, have been used at the rate of 1 lb. per plant in the first year and 2 lbs. per plant per year thereafter. These dressings have been divided into four equal parts and applied quarterly.

Routine maintenance has been hand-weeding round the plants, slashing the undergrowth and thinning out of surplus bananas and Manila hemp pseudostems, which have been cut up and used as a mulch round the cacao. Shade trees have been pruned to encourage high overhead shade.

ESTABLISHMENT OF FIELD 44c.

This field was under secondary jungle and establishment has proved easier. The undergrowth was lightly slashed and holing, 12 x 12 ft., done by hand labour. A basketful of cattle manure was incorporated in the top soil and the cacao seedlings planted as in Field 44a. No artificial shade was used. As the cacao grew, the jungle shade was gradually thinned where necessary. Cost of maintenance was low as ring weeding and slashing were required only every two or three months. Manurial treatment since planting has been the same as that in Field 44a. There was no trouble from pests, and therefore no spraying has been done.*

* Recently there was a mild attack of *Helopeltis* which was brought under control by two rounds of spraying with Accotox at 0.2 per cent. at fortnightly intervals.

PLATE I

Amelonado seed garden, Field 44a, Federal Experiment Station, Serdang. Planted March, 1950, photographed December, 1950. Note the inadequate shade.

PLATE II.

As Plate I. but photographed March, 1952. Note the improved shade provided by Gliricidia, Manila hemp and bananas.

PLATE III.

Amelonado seed garden Field 44c, Federal Experiment Station, Serdang. Planted under secondary jungle. Photographed March, 1952. Note the good shape of the cacao and absence of scorch or insect damage.

PLATE IV.

Field 44a. An Amelonado tree photographed April, 1953. This was 40 months old from seed and carrying a good crop of pods.

PLATE V.

Field 44a. Photographed July, 1951. Scorch resulting from inadequate shade.

PLATE VI.

An Amelonado cutting planted at Jerangau Estate, Trengganu, in October, 1951, and photographed in June, 1953, (20 months) carrying its first pods (Photo by courtesy of Malayan Cocoa Ltd.)

The plants in this field are short compared with those in Field 44a but are well shaped, sturdy and of uniform growth. But flowering and vegetative growth have been slower than in Field 44a.

Comparison of Establishment Methods.

The general impressions from these two areas may be summarised as follows:—

Field 44a, Establishment from Cleared Land.

Cost of erecting fronds around plants was very high. Cost of establishing shade species itself was heavy as most of them required good treatment and liberal manuring before they grew satisfactorily. Pest damage has been great and the cost of pest control very high. Clearly it would have helped if the shade had been well established before the cacao was planted.

Field 44c, Establishment Under Secondary Jungle.

Preparation of the land and subsequent maintenance was inexpensive. Pest damage was negligible. The cacao has not grown so vigorously but looks healthy and well shaped.

Yield from the Seed Gardens.

Field 44c. has so far yielded few pods. Field 44a has given heavier crops than was expected. From the 891 trees planted in March, 1950, a total of 147 pods was harvested in 1952. During the first six months of 1953 the crop has been 2,073 pods. These figures are considered satisfactory. A tree in bearing is illustrated in Plate IV.

Establishment of Further Seed Gardens.

Clearly it was desirable to have further seed gardens established as soon as possible in all areas in which cacao is likely to be grown commercially. In order to get these established quickly the following action was taken. A half acre plot was planted early in 1950 with Trinitario stocks spaced 6 x 4 ft. under shade of *Erythrina subumbrans*. In January, 1951, the Trinitario stocks were budded with Amelonado (7). This area has been utilised as a budwood area and as an area from which Amelonado cuttings could be collected. During the period November, 1951, to March, 1953, 11,000 cuttings were collected, of which 7,020 were successfully rooted (60 per cent.). However, only 5,858 were successfully hardened (53 per cent.) and 4,665 (42 per cent.) actually distributed to seed gardens. More budwood was available than could be used, as sufficient suitable stocks were not available.

In each State and Settlement suitable sites have been selected for use as Departmental seed gardens. Planting of these commenced in November, 1951, and has progressed steadily. At first the planting material was either cuttings or buddings, but as the Serdang seed garden

Table IV.

Number of Plants in the Amelonado Seed Gardens as on the 1st June, 1953.

	Planted.			In Nurseries.			
	Seedlings.	Cuttings.	Buddings.	Seedlings.	Cuttings.	Station Totals.	State Totals.
KEDAH & PERLIS.							
Sik	317	139	—	1,108	—	1,564	
Baling	407	150	—	493	—	1,050	
Gajah Mati	929	—	3	290	—	1,222	
Perlis	80	—	—	350	—	430	4,266
KELANTAN.							
Batang Merbau	50	250	—	3,735	—	4,035	4,035
TRENGGANU.							
F.E.S., Jerangau	854	172	64	660	—	1,750	1,750
PENANG & P.W.							
B. Mertajam	—	32	74	—	15	121	
Ayer Itam	80	70	221	—	—	371	492
PERAK.							
Degong	252	—	1,309	—	—	1,561	
Layang Layang	146	254	100	—	—	500	
Selama	51	162	—	—	—	213	
Kuala Kangsar	—	—	—	4,000	—	4,000	6,274
SELANGOR.							
Subang	340	632	—	3,200	—	4,172	4,172
PAHANG.							
Pekan	—	—	255	—	—	103	
Temerloh	—	—	78	25	—	255	
Kuala Lipis	200	70	40	—	—	310	668
N. SEMBILAN.							
Ampang Tinggi	—	115	—	862	—	977	977
MALACCA.							
Sungai Udang	161	205	277	—	—	643	643
JOHORE.							
Batu Pahat	—	540	—	—	—	540	540
Total	3,867	2,791	2,421	14,723	15	23,817	23,817
Grand Total	9,079			14,738		23,817	

has come into bearing the use of vegetatively propagated material has been stopped and now only seedlings are being planted. Table IV shows the number of plants in the Departmental seed gardens as on the 1st June, 1953. It will be seen that one or more seed gardens have been established in each State and Settlement. Amelonado planting material has also been supplied to various estates including Jerangau Estate (Malayan Cocoa Ltd.), Trengganu, who have received material for about 60 acres—the first commercial planting of cacao in Malaya.

Limited commercial planting, using the pods from the Serdang seed garden, will be possible from late 1953 onwards. Within about two years there should be a large supply of planting material from the new seed gardens, and the initial shortage which has held up planting of cacao in Malaya will have been overcome.

Discussion.

Amelonado cacao has been shown to be vigorous, and the early yields have been satisfactory. It is not yet possible to predict the yields that may be expected in Malaya from Amelonado cacao in full bearing.

The pods have been shown to be remarkably uniform and to contain an average of 112 gms. of wet cacao, which is satisfactory. The fermented and dried beans have been found to be of a size acceptable commercially, but only a small sample has yet been submitted for commercial appraisal; there is, however, every reason to believe that manufacturers will be pleased to accept Amelonado cacao from Malaya.

It can safely be stated that no better planting material is at present available in Malaya. It is not yet possible to determine which, if any, of the other types of cacao introduced into Malaya will prove superior to Amelonado.

The alternatives to Amelonado are: (a) Trinitario clones, (b) Trinitario clonal seed, or (c) the Upper Amazon variety. To consider each of these in turn:—

(*a*) *Trinitario Clones.* There is as yet no single Trinitario tree in bearing in Malaya which is as promising as open pollinated Amelonado. Over 2,000 recently imported Trinitario seedlings are coming into bearing at the Federal Experiment Station, Serdang, but several years' records will be required before they can be selected. Subsequently, clonal trials will have to be planted and allowed to come into bearing. A clone superior to the Amelonado variety may then be found. Clearly this will take at least five years and probably ten. Recognised clones from other territories (mainly Trinidad) are being imported, with due phytosanitary precautions, but it will be necessary to multiply this material and prove the clones under local conditions before they can be released.

(*b*) *Trinitario Clonal Seed.* This will take as long to prove as a Trinitario clone, so again no early results are to be expected.

(*c*) *Upper Amazon Cacao Seed.* This has only recently been imported. The variety is known to be complex and to include several strains. There have also been some doubts from the manufacturers about

the quality of the dried beans. Thus, although the variety is capable of very high yields there are a number of problems to be solved before it can be recommended for commercial planting.

It can therefore be assumed that no clone or variety superior to Amelonado will be available for commercial planting in Malaya for five to ten years.

Summary.

Amelonado cacao was introduced into Malaya in November, 1949. The history of Amelonado cacao in Malaya up to June, 1953, is recorded and the reasons for recommending this variety for commercial planting are given.

Acknowledgements.

The Director of Agriculture, Mr. O. J. Voelcker, C.B.E., has not only formulated general policies but has also given advice on the practical problems which have arisen almost daily. The present promising position of cacao in Malaya is due largely to his untiring interest and guidance.

Numerous other officers of the Department of Agriculture have made valuable contributions to the progress of Amelonado cacao in Malaya. Without their help this article could never have been written.

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FURTHER NOTES ON THE MARKETING OF SMALLHOLDING LATEX

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Introduction.

In Malaya's economy, rubber is the most important of the exportable crops. It is grown on both plantation and smallholding scales, the latter producing roughly 43 per cent. of the total output of rubber which, in 1952, approximated to 583,000 tons in the form of sheet rubber and concentrated latex. The competitive nature of the rubber market, particularly since the introduction of the synthetic article, requires that as high a quality natural product as possible should be marketed, and furtherance of this policy in Malaya is seen in the introduction of, firstly, the Rubber Shipping and Packing Control Ordinance (1) and, secondly, the Technical Classification of Rubber (2 and 3). Both aim to maintain the competitive position of natural rubber, the former by ensuring that the rubber exported is up to the quality that the shipper has contracted to supply, and the latter by producing information about the physical properties of the rubber in both the raw and vulcanised states.

The application of the Technical Classification Scheme has yet to be extended to the lower grades of rubber which, unfortunately, constitute the bulk of production from smallholdings. It is left to the economist to gauge what this means in terms of the country's economy while it behoves those technically concerned to explore every avenue in order to evolve methods, acceptable to smallholders, which lead to a significant overall improvement in the quality of rubber marketed by smallholders.

Centralised bulk processing of smallholders' latex may provide a part answer to the problem, and in a previous article (4) the development in Kedah of small organisations with that object in view was described. The purpose of the present article is to review, after a lapse of three years during which period there were extreme fluctuations in commodity prices, the progress made in Kedah and Perlis and briefly record development trends in other States.

Progress in Kedah and Perlis.

KEDAH.

In the afore-mentioned article three possibilities for future development were suggested, namely:—

(a) collection of latex through approved agents or agencies and eventual processing by large commercial concerns;

(b) formation of a co-operative movement in the *kampong* * to undertake collection and bulk processing; and

(c) a combination of (a) and (b).

All three systems were operated during 1950 with a marked tendency in favour of (a). This was understandable because, as long as a brisk demand was maintained for latex by the large, local company interested in the export of boosted latex, collectors, in contrast to the collector/processors, were assured of a very rapid turnover making for larger profits, lower capital expenditure and freedom from marketing problems. In consequence, the year 1951 saw, with one exception, a complete changeover to simple collection of latex for subsequent sale as latex, and this system has since continued. The exception was the co-operative collection and bulk processing centre at Pantai Prai which, unfortunately, ceased operations at the end of 1952, reportedly because of the low price of rubber, disloyalty amongst the members and the machinations of unlicensed rubber dealers.

The annual weight of dry rubber purchased as latex from smallholders during the last three years and the net value paid to them after making deductions for duty, cess and miscellaneous charges are given in Table I.

Table I.

Weight and Net Value of Latex Purchased from Kedah Smallholders.

Year.	Weight.	Net Value.
	Dry Tons.	$
1950	580	1,389,068
1951	819	2,507,639
1952	702	1,230,115

The sudden drop in the price of rubber in the second half of 1952 had an adverse effect on the total turnover for the year.

Most rapid development was achieved through the medium of private rather than co-operative enterprise and may be explained partly by the absence of the co-operative spirit and partly by the fact that circumstances favoured the type of centre which collected latex for almost immediate disposal as latex. A large working capital was not therefore required to operate these collection centres and management was well within the individual scope of the more enterprising smallholders. Not only, however, did the sudden drop in commodity prices in 1952 give rise to unfounded rumours of a restricted market for latex with possible

* A village.

stoppage of business but it also served, in a very marked way, to emphasise the unstable future for centres of this type.

For a number of reasons, *inter alia*, a growing awareness that lasting progress for smallholding projects can best be achieved by the operation of completely independent units, the necessary working capital may be more readily obtained through the aegis of a Co-operative Society and, lastly, the Rural and Industrial Development Authority's policy of encouraging any sound business enterprise launched by smallholders, the tendency in the latter part of 1952 was in favour of co-operatively-managed collecting-cum-processing schemes. Such a one was about to begin operations at Baling with plans for two others under consideration. It had originated as a large latex collection organisation, privately run, but the incentive of apparently easy profits led primary producers to form themselves into a syndicate and take over the business. As long as rubber continued on a rising market there was business harmony with reasonably easy profits, but it did not last and mismanagement soon led to a sharp decline in business and threatened bankruptcy. Eventually a co-operative society was formed to take over the management, and with a $20,000 loan from the Rural and Industrial Development Authority proceeded to erect a modern factory for the bulk processing of members' latex. It was expected to begin functioning early in 1953.

The number of licensed latex dealers at any one time was never less than eight or more than eleven and between them they operated from 14 to 30 collecting centres. No limits were placed on the number of centres a licensee cared to operate but very definite working areas were defined by the District Licensing Boards. Any attempt at encroachment into another's territory was not tolerated and if persisted in in the face of a written warning the penalty was cancellation of the licence. There has been only one recorded case of licence cancellation.

In the evolution of a business enterprise for smallholders, such as is being discussed, there is a limit to the part which should be played by the promoters, particularly those in Government Service, and it is argued that they, having launched it after adequate demonstration of its practical and economic soundness, should be content gradually to exercise less and less control leaving the actual operators and the clients mutually to work for lasting success. This was the policy followed having regard, of course, to the gradual improvement in skill and aptitude of the operators, and by the end of 1950 the stage was reached when only remote control was exercised by officers of the Rubber Research Institute and Department of Agriculture. It was emphasised, however, that, although active participation in the affairs of the various centres would become progressively less, advisory assistance would always be forthcoming on request. Unhappily, with relaxation of control, business efficiency deteriorated and it was not long before the bulk latex purchasing company lodged complaints of neglect on the part of the collectors to follow specific instructions for ammoniation of latex, failure to maintain a reasonable standard of cleanliness of latex handling equipment and

habitual dilution of latex with water. A general improvement did result when warning notices were issued by the Company to the effect that contracts would be cancelled unless more attention was paid to instructions, especially those regarding ammoniation, but it was not sustained and the firm was forced to arrange, at the beginning of 1952, for a weekly inspection and cleaning team to visit the offending centres. The costs for this service were debited against the purchase price of the rubber. Current standards, though still below par, are definitely better than those of 1951 and only a small core of habitual offenders persisted, for whose existence the prevalence of a sellers' market in latex was undoubtedly responsible.

The integrity of primary producers was not always of the highest, some of the more unscrupulous resorting to various subterfuges to adulterate the latex and so gain at the expense of the licensee. The juice of certain trees, tapioca starch and soapy water have all, on occasion, been added to the latex to produce an artificial metrolac reading. It has even been known for a producer to bring hot water in a vacuum flask specially to add to his latex immediately prior to d.r.c. * determination. Licensees have also found it expedient frequently to switch metrolac readers who, as a body, appeared to have a failing for accepting small gratifications in return for enhanced readings in favour of their friends.

For dry rubber content determination the metrolac was generally favoured on account of the ease and quickness in manipulation, and resort to the "chee" † system made only when cheating was suspected.

Certain of the more enterprising licensees have been quick to utilise modern appliances in the furtherance of their business. For instance, in an isolated area a wireless set was invaluable for obtaining the daily noon rubber quotations on which transactions are based. Again, the popular kerosene oven has come to supplant the old wood-burning type for the drying of "chee" samples.

PERLIS.

The task of development was less easy in Perlis, for not only was the acreage under rubber smallholdings inextensive—3,428 acres—but markets for both latex and processed sheet were at some considerable distance away entailing long road haulage. Two combined collection and processing centres functioned in 1950, 1951 and part of 1952, when both finally closed down, the combination of business ineptitude and the continued mistrust of the system on the part of the primary producers proving too great a handicap to overcome when prices suddenly dropped. An attempt to take over one of the centres as a Co-operative Society had no support from the smallholders. Production of smoked sheet for the three years was reported at 17, 24 and 11 tons respectively.

* d.r.c. = dry rubber content.

† "Chee" = a measure used in determination of d.r.c.

PLATE I.

Typical latex collection centre in Kedah.

PLATE II.

Smallholders delivering latex to the collection centre.

PLATE III.

"Old" and "New" type ovens used in determination of d.r.c. of latex.

PLATE IV.

Bulked latex purchased from smallholders being transferred to tank lorry.

Development in Other States.

KELANTAN.

No development of any import has taken place.

TRENGGANU.

Two small collection and processing centres operated during 1951 and 1952 in a very modest fashion.

PENANG AND PROVINCE WELLESLEY.

There was no development of any kind.

PERAK.

Due to the absence of a commercial demand for latex on a large scale, the type of centre which developed, with two exceptions, was exclusively for collection and bulk processing. It was reported that 12 such centres were operating in 1950 but the number had dropped to four by the end of 1952. The comparatively slow progress recorded in respect of an important rubber-growing State like Perak serves to draw attention to the much greater obstacles which have to be surmounted by collection-cum-bulk processing centres than by the simple collection centres such as operated in Kedah, and it is abundantly clear that, in the early stages at least, they need a great deal more supervision and patient encouragement.

SELANGOR.

In contrast to Perak, Selangor, with approximately half the acreage of smallholding rubber, had the advantage in 1951 of the stimulus provided by a commercial market for latex, and most operators of the 16 centres were able to consolidate to such good effect that when this market ceased in 1952 they were able to turn to bulk processing on their own behalf without undue difficulty.

PAHANG.

Three small-scale enterprises embracing bulk processing as well as collection were begun in 1950 and all appeared to operate efficiently during the three years. The establishment of a large co-operatively managed bulk processing centre at Temerloh, with assistance from the Rural and Industrial Development Authority, was under consideration.

NEGRI SEMBILAN.

Collection of latex for sale as latex was undertaken in a small way in 1950 but increased ten-fold in 1951. A discriminatory buyers' market in 1952, however, was directly responsible for the disruption of many small, privately-run businesses and undoubtedly was partly responsible for the revival of interest in co-operative collection, processing

and marketing which later became manifest. Draft schemes for centres similar to the one in Malacca (Sungei Buloh) were in hand at Port Dickson and Kuala Pilah.

MALACCA.

A beginning was made in 1951 with two, small, collection-cum-processing centres, the number increasing to three in 1952. The development has been on sound lines and the small co-operative centre at Sungei Buloh is a worthy example of what industry, patience and mutual co-operation can achieve (5).

JOHORE.

After a slow start in 1950, Johore, by virtue of possessing the largest acreage of smallholding rubber in Malaya and having the additional advantage of a large commercial demand for latex, rapidly came to the fore in 1951 as the largest handler of smallholding latex. Development was similar to that in Kedah with emphasis on the purely collection type of centre. Satisfactory though the progress may have been, it was recognised that it could not be classed as an example of sound development mainly because of the uncertain future of the collecting centres arising from their dependence on a limited market, and that the policy should be to encourage the introduction of the completely independent collection and bulk processing type of centre. A project, in the nature of a pilot scheme, was therefore sponsored by the Rural and Industrial Development Authority which provided for the erection of a large, modern, co-operatively managed factory at Grisek to bulk-process the rubber latex drawn over a wide radius from the surrounding smallholdings. The scheme was first mooted in 1950 but the factory, designed to process 4,000 lbs. of rubber daily with provision for extension to 6,000 lbs., was not expected to commence operations until about April, 1953. This bold experiment and the impact it has on the rubber smallholding industry will undoubtedly be very closely watched.

Pan-Malayan Statistics.

In the following tables the data have been extracted from the Annual Report, 1951, of the Smallholders' Advisory Officer, Rubber Research Institute of Malaya, and memoranda submitted by the various State Agricultural Officers. Latex collection was in the early stages of development in most States in 1950 and records of the rubber handled are incomplete. Data in respect of tonnages for 1951 are available and, together with the estimated value of the rubber, calculated in respect of each State at the equivalent net rate obtained by smallholders in Kedah, are appended in Table II. Although complete data for 1952 are still pending it is a fair assumption, based on opinions submitted by the various State Agricultural Officers, that decreased turnover in certain States has been offset by increases in others and, on balance, the 1952 pan-Malayan weights of rubber purchased from smallholders as latex approximated to that of 1951.

Table II.

Collection of Latex From Smallholdings in 1951.

State or Settlement.	Weight of Latex.	Net Value.
	Dry Tons.	$
Perlis	22	67,360
Kedah	819	2,507,639
Kelantan	—	—
Trengganu	6	18,371
Penang and Province Wellesley	—	—
Perak	151	462,336
Selangor	917	2,807,698
Pahang	69	211,266
Negri Sembilan	730	2,235,136
Malacca	9	27,556
Johore	1.627	4,981,597
Total	4,350	13,318,959

In Table III are given the numbers of each type of centre in operation during the three years under review.

Table III.

Number of Centres In Operation, 1950 to 1952.

State or Settlement.	Collection Only.			Collection and Processing.		
	1950	1951	1952	1950	1951	1952
Perlis	—	—	—	2	2	2
Kedah	14	30	23	5	1	1
Kelantan	—	—	—	—	—	—
Trengganu	—	—	—	—	2	2
Penang & Province Wellesley	—	—	—	—	—	—
Perak	1	2	1	12	10	6
Selangor	12	16	5	1	2	21
Pahang	—	—	1	3	3	4
Negri Sembilan	29	33	27	—	4	4
Malacca	—	—	—	—	2	3
Johore	9	23	31	2	2	7
Total	65	104	88	25	28	50

The capacity of the different centres varied, with ½ to 10 piculs* dry rubber per day as the extreme limits. Most centres were predominantly Malay owned.

* 1 picul = 133⅓ lbs.

Summary and Conclusions.

Individually processed smallholding rubber produces, in practically every instance, rubber of notoriously low quality. Endeavours to improve on this unsatisfactory state of affairs resulted in the introduction in Kedah, in 1949, of an alternative system which encouraged smallholders to sell their rubber as latex and had as its key to success the centralised bulk processing of that latex under efficient management. The idea was adopted in other States and a similar pattern of development was followed throughout the Federation. Collection was undertaken by individuals, syndicates or co-operative societies and, depending on whether there was a commercial demand for latex, as in Johore, Selangor and Kedah, the collected latex was either sold to the large firms as latex or, if not, was bulk processed by the collectors. The operation of collection centres disposing of the latex as latex involved no great capital outlay or business ability, consequently their rate of establishment was quick and for the most part they were privately run. They had, however, one big drawback, their future was uncertain for they were entirely dependent on the demands of a limited market in the shape of a few large firms interested in the export of boosted latex. It may be remarked that a number of the operators had the foresight to equip a small factory for bulk processing in case of sudden closure of the latex market, but they were in the minority.

The progressive development of the other type of centre, i.e. collection-cum-bulk processing, may have been slower due largely to the fact that a considerable capital outlay was required as well as skilled factory management and ability to grade and market the produce. But there is no doubt that when established on sound business lines, and there is ample evidence of the existence of numerous such centres throughout Malaya, this type is the one with the more stable future and, in consequence, of greater potential worth to the smallholding rubber industry. Lack of the necessary capital combined with an uncertain market and low prices probably accounted for the disinterest shown in 1952 by private enterprise in this type of centre, and its appears that extension would best be served by the active encouragement of co-operatively managed projects.

Considered in the light of total production from smallholdings, the volume of rubber handled by the new system may be considered almost infinitesimal, in 1951 it represented less than 2 per cent., yet it was sufficient to demonstrate that the idea, with a little foresight and patient encouragement, could lead to important developments not only as regards rubber but other crops as well.

Acknowledgements.

Without the ready co-operation of the Manager, Process Department, Harvard Estate, Kedah, and the willing assistance given by the three Malay Rubber Instructors in Kedah, this article would not have been written.

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NOTES ON CURRENT INVESTIGATIONS, APRIL TO JUNE, 1953.

Compiled by the Chief Research Officer and the Acting Senior Agronomist.

Padi.

Wet Padi Manurial Trials.

Further results of the 1952-1953 wet padi experiments were received during the quarter. Those of the 50 manurial trials on cultivators' land in Province Wellesley have been analysed. Positive responses to manuring are revealed, as in the trials carried out in Kedah and reported at the end of last quarter. Treatments and mean yields are given in Table I.

Table I.

Manurial Trials on Cultivators' Land in Province Wellesley.

Treatments and Mean Yields.

Treatments. (fertilisers in lbs. per acre)	Yields. (in lbs. grain per acre)	
	Province Wellesley North (30 sites).	Province Wellesley Central (20 sites).
A. 100 lbs. P_2O_5 as bat guano + 30 lbs. N as sulphate of ammonia	2,302	2,538
B. 100 lbs. P_2O_5 as Christmas Island rock phosphate + 30 lbs. N as sulphate of ammonia	2,473	2,483
C. 50 lbs. P_2O_5 as double superphosphate + 30 lbs. N as sulphate of ammonia	2,372	2,621
D. Control—no fertiliser	2,103	2,299
General Means	2,312	2,485

Effects of manuring and of source of phosphate (local bat guano and imported fertilisers) are shown in Table II.

Table II.

Manurial Trials on Cultivators' Land in Province Wellesley.

Effects of Manuring and Source of Phosphate.

(Yields in lbs. grain per acre)

Locality.	Effect of Manuring.			Effect of Source of Phosphate.		
	Mean Yield Treats. A, B & C.	Mean Yield Treat. D.	Effect (Difference).	Mean Yield Treats. B & C.	Mean Yield Treat. A.	Effect (Difference).
P.W. North	2,382	2,103	279 ± 53.78 **	2,422	2,302	120 ± 57.04 *
P.W. Central	2,547	2,299	248 ± 26.31 **	2,552	2,538	14 ± 27.91

It is concluded that any of the manurial mixtures used in the trials will be likely to increase yields of grain but that the extent of the increases may vary considerably from those obtained in the trials. The evidence provided by the investigation is not definite enough to warrant any conclusion being drawn in regard to differential effects of local and imported phosphate. It is clear that the cheapest manure (Mixture A—bat guano and sulphate of ammonia) is the soundest that can be recommended at present.

Brief reference to other results indicates that there have been most encouraging responses to manures on granite wash soils in Perak and Pahang, and that growth was very poor in trials incorporating major nutrients and minor elements on peat in Selangor.

The experimental programme for the 1953-1954 season is almost finalised; broadly, it should follow that of last season. The main addition is a trial designed to test various methods of applying nitrogenous manures after transplanting.

Variety Selection.

Analysis of selection work has been completed, with the exception of Acheh Puteh in Selangor. The position is summarised in Table III.

** Significance at the 1 per cent point.

* Significance at the 5 per cent point.

Table III.

Variety Selection.

Variety, Station, and Number of Lines Carried Forward.

Variety.	No. of Lines Carried Forward.		Station.	
	1952-3.	1953-4.		
Serendah Kuning	50	50	Kendong, Ampang Tinggi, Ulu Klawang.	
Nachin	42	42	Pulau Gadong.	
Siam	75	40	„ „	
Mayang Sa Batil	60	40	Genting.	
Seraup	99	45	Titi Serong.	
Radin Ebos	83	50	Telok Chengai.	
Anak Naga	518	ca. 250	Kota Bharu.	
Mayang Sa Gumpal	F.S.	1,000	Jelawat.	
Seri Raja	F.S.	1,000	Talang.	
„ „	F.S.	1,000	Simpang Tiga.	
Kontor	F.S.	1,000	Bukit Merah.	
Serendah Puteh	—	F.S. *	Kendong, Ampang Tinggi, Ulu Klawang.	New projects.
Machang	—	F.S.	Titi Serong.	

There was no serious incidence of pest or disease on any of the selection plots during last season, and yields were on the whole slightly greater than the previous year.

Selection of Mayang Sa Batil and Radin Ebos is now reaching its final stages and variety trials incorporating the apparently superior strains will be laid down this coming season.

Hybridisation.

Examination of last year's crop and results from the four *indica* x *japonica* crosses was completed at Pulau Gadong, Malacca. Outstanding plants have been selected for ear-rowing next season, while bulked seed will be sown again for reselection.

* Foundation Stock.

A total of 248 ear rows and 18 selection plots will be grown at Pulau Gadong, Malacca, and or Telok Chengai, Kedah, in the 1953-54 season.

Seed of 34 more *indica* x *japonica* crosses has been received from Cuttack, India, recently and will be grown both at Pulau Gadong and Telok Chengai this year in selection plots.

Local hybrid material from crosses made in 1950 and 1951 has been examined and selections made for growing in the coming season at Pulau Gadong and Telok Chengai. The nine 1950 crosses have given 768 types now in ear-rows and 28 definite crosses have resulted from further hybridisation work carried out in 1951.

Hydroponics.

Attempts have been made to grow padi in hydroponic solutions in order to discover and characterise symptoms of deficiency of nitrogen, potassium and phosphorus. Growth of the padi in these solutions has generally been very poor and an attempt is now being made to grow padi in sand culture.

Padi Leaf Analyses.

During the period January to March, 1953, 100 samples of padi leaf taken at the flowering stage were received and these have been analysed in order to study the increase in uptake of plant nutrients when fertilisers are applied to the soil. Nitrogen, ash, K_2O, P_2O_5, MgO and CaO were determined on samples from four experiments in Kelantan (Kn. 78), Bukit Merah, Province Wellesley, (19/51), Perak North (8/51) and Malacca (M33). These experiments (mixed major elements) were in Latin squares with five treatments as follows:—

A	N.P.K. + Ca
B	N.P.K. + Mg
C	N.P.K. + Mg + Ca
D	N.P.K.
E	Control.

The results of chemical analyses have been analysed statistically and the following is a summary of the results:—

Kelantan 78.—Treatments B, C and D all gave a significantly higher content of *nitrogen* than the control E (5% point). Treatment A was almost significant. This was the only experiment where a significance for nitrogen was obtained and none of the other nutrients was significantly higher than the control.

Malacca 33.—Treatments A, B and C all gave a significantly higher content of P_2O_5 than the control (5% point). Treatment C was also significantly higher than D. Treatments A and C gave a significantly higher content of K_2O than the control (5% point). Treatment C gave a significantly higher content of *MgO* over A, B, D and E. (5% point). Treatment A was also higher than D and E.

Bukit Merah 19/51.—Treatments A, B, C and D all gave a significantly higher content of P_2O_5 than the control (1% point). Treatments A, B and C gave a significantly higher content of *CaO* than the control (5% point). Treatment A was also higher than D and E.

Perak North 8/51.—The ash in the control was higher than in treatments A, B, C and D (5% point).

To sum up, there was an increased uptake of nitrogen only in the plants in Kelantan. There was increased uptake of P_2O_5, CaO and MgO in Malacca. At Bukit Merah, uptake of P_2O_5 and CaO was increased, while in Perak North, treatments resulted in decreased ash content. These results are of sufficient interest to justify repeating the analyses for a second year.

Disease Control.

In germination tests carried out to discover whether samples of padi seeds were free from disease, the commonest organism to appear on unhealthy seeds was *Trichoconis padwickii*. *Helminthosporium oryzae* also developed and sporulated in these tests. This early sporulation of *Helminthosporium* indicates that infected seed may often be the cause of early outbreaks of the disease in nurseries.

Mechanical Cultivation and Manuring of Dry Padi.

It has been shown that all stages of dry padi cultivation can be mechanised in Kelantan. Manurial trials confirmed previous findings that manures increased yields, and added weight to the suggestion that nitrogen was probably the most effective nutrient in this respect, providing others were present in adequate amounts. A comprehensive factorial trial designed to test various combinations of times of application and quantities of sulphate of ammonia has been proposed for the 1953-1954 season.

Cacao.

Growth was mainly good at the Federal Experiment Station, Serdang. The West African Amelonado looks the most vigorous and promising of all the material planted on the Station, while the Criollo cacao is the least satisfactory. Attacks by *Helopeltis* bugs were widespread but were effectively controlled in most cases. Monkeys and squirrels exacted a heavy toll of pods in the main yielding areas.

The following Amelonado material was distributed during the quarter:—

Cuttings	50
Seedlings	100
Pods	1,659
Budwood	56 yds.

Recording of the increased crop at Serdang has been put on a routine basis. Clip cards are being used for this purpose. 2,190 pods were opened and analysed during the quarter.

The Serdang crop is being fermented and dried whenever crops are large enough to justify fermentation. The wet weather has made sun drying a precarious procedure.

Growth of clonal cacao on a Penang estate is reported to have been very good indeed.

Establishment of the large intercropping experiment on Gajah Mati Experiment Station in Kedah made good progress; lining, holing and planting of various shades and ground covers were accomplished. It is reported from the Federal Experiment Station, Jerangau, Trengganu, that budgrafting was carried out with much greater success than in the last quarter.

Disease Control.

Red root (*Ganoderma pseudoferreum*) continues to be the most serious disease of cacao and has recently occurred for the first time on post-war plantings at the Federal Experiment Station, Serdang. In one case the source of infection was a jungle stump, while in another it was a length of infected root which had been dropped on the surface of the soil near a cacao tree.

Brown root disease (*Fomes noxius*) was recorded for the first time on cacao in Trengganu.

Oil Palm.

In connection with the exchange programme with the Institute de Recherches pour les Huiles et Oleagineux (I.R.H.O.), several consignments of pollen and seed from dumpy palms have been despatched to Paris. In exchange a total of three consignments of "pisifera" pollen have been received.

Replanting Trial.

Felling of old palms began in the final treatment (felling of old palms three years after replanting) of the replanting trial at the Federal Experiment Station, Serdang. Vigour of replants is clearly associated with early felling of old palms. Young palms in the early-felled areas (that is, in areas where old palms were felled prior to and one year after replanting) are beginning to flower; elsewhere they are barely surviving

Leaf Analysis.

A summary of the results to-date was given in the last quarterly report, and here it will be sufficient to report that the investigations are being continued. A further 100 samples were taken from the Federal Experiment Station, Serdang, both frond 3 and frond 17 being sampled, and 16 samples were obtained from Highlands Estate, Klang, where the nutrient content of the leaves of young palms is being investigated.

Coconut.

Mechanical inter-row harrowing appeared equally effective with hand slashing on a Selangor estate and is much cheaper.

A method of erecting a ladder and platform to facilitate controlled pollination has been evolved. The cost is about $300 per palm.

Fibres.

Manila hemp grew well in a varietal trial on a Selangor station but ramie was less satisfactory. Preparations were also made at this site for the repetition of a jute manurial trial.

Stem canker (*Colletotrichum capsici*) continues to cause trouble on jute; the variety Segama is very susceptible. Cankers frequently appear just above soil level, weakening the stem and causing it to collapse and break.

The technique of extracting ramie fibre has been further improved and a few entirely satisfactory samples prepared.

Tea.

Vegetative Propagation.

The "take" of cuttings in the new rooting trial at the Federal Experiment Station, Serdang, appears to be very good. Figures are not yet available.

Various techniques have been investigated at Cameron Highlands. with a view to improving vegetative propagation methods. It appeared that young, red wood, with just-opened buds, rooted better than did green wood; that root growth was accelerated, after callus formation, if cuttings were transferred from propagation beds to rich, well prepared soil; and that liquid cattle manure was beneficial in promoting root growth.

Copper Treatment.

The scope of this experiment has been extended. Formerly 500 bushes were treated with copper sulphate (5 gms. on the soil round each bush), but this number has now been increased to 1,000 bushes, since one plucking from 500 bushes was not sufficient to give a full charge for tea-making. The bushes were treated on the 29th April, 1953.

Disease Control.

Blister Blight (Exobasidium vexans).

A test of two recently obtained fungicides (Copper Sandoz and Fernide) has been completed. Compared with Perenox (0.25%) both fungicides gave satisfactory results. Copper Sandoz (0.25%) was particularly promising, while Fernide (0.4%) gave adequate control.

Pineapple.

Growth in experiments on peat soil at Jalan Kebun, Selangor, is generally excellent. There are some 10 to 12 trials at this station involving manuring, varieties, disease control and cultivation treatments.

Selection.

The clonal and mass selection plots at Jalan Kebun, Selangor, have shown continued good growth, and records of differences in vegetative habit have been taken.

Manurial and Cultural Trials.

Results from a trial, in which types of potash and methods of application were tested, showed that scorching of leaves was severe when muriate of potash was mixed with peat and applied in outer leaf axils but that no scorching appeared when the sulphate form of potash was similarly used. Growth in another trial is better on ridges than on the flat.

Pest Control.

The susceptibility to mealy-bug wilt test with Sarawak pines mentioned in the Report for the first quarter has been delayed slightly by initial poor growth of the plants, and inoculations have not yet been made.

The name of the pineapple mealy-bug previously referred to as *Pseudococcus brevipes* (Ckll.) should correctly be *Dysmicoccus brevipes* (Ckll.).

Pasture and Fodder.

Pasture.

Growth of pasture in a manurial trial at the Federal Experiment Station, Serdang, was exceptionally good; the best plots were those treated with double doses of nitrogen and potash.

Fodder.

A total of 199 samples of fodder grasses from the Federal Experiment Station, Serdang, has been analysed during the quarter.

It will not be possible to get an adequate picture of the influence of fertilisers and shade on fodder grasses until further analyses have been carried out and the results analysed statistically.

Varieties showed marked differential growth in a Napier grass varieties and manures trial at Serdang.

Vegetables and Food Crops.

Vegetables.

Variety "Kedah" appeared best of those tested in a Selangor trial of brinjal varieties.

Fertilisers.

A compound fertiliser containing soya bean and groundnut cakes and an N.P.K. fertiliser gave almost double the yield of beetroots given

by either prawn dust or "Sterameal" (Black Label) and an N.P. mixture in a trial at Cameron Highlands.

Groundnut.

Single plant selections were made from the last crop and are growing at the Federal Experiment Station, Serdang. Growth has been very good and large differences in vegetative habit are apparent.

Bacterial Wilt of Tomato.

In the experiment on control of bacterial wilt (*Xanthomonas solanacearum*) of tomato by soil treatment with DD soil fumigant and crop rotation, the disease caused serious damage to all tomato crops grown during the quarter. Weather at the time was rather wet and it is evident that control measures which are adequate during drier weather are not effective in the wetter periods of the year.

Onion Leaf Miner.

The imported onion fly *Dizygomyza cepae* Hering, recorded from Singapore in 1952, appears to be firmly established on the mainland and has been reported from Muar in Johore, and from Serdang Bahru and Sungei Buloh in Selangor.

Tests with a dieldrin spray carried out at the Naval Base, Singapore, have not been conclusive. Less attack was experienced after spraying, except in one case, but it is reported that the ground was rested for three months and this may have been responsible for the reduction in fly damage.

A trial with dieldrin, aldrin and BHC against this fly is in progress at Serdang Bahru. Results will be reported in due course.

Fruits.

The rambutan and durian clonal trial at Serdang looked extremely well during the quarter. Rambutan variety trials are also in progress in Perak. The quality of King oranges from a Perak manurial trial is reported to be most disappointing. Progress was made in the establishment of a Kwini/Mango trial at Degong, Perak.

Livestock.

Goats.

Eleven kids were born at Serdang.

Two further animals reached the pre-defined slaughter weight in the Penang feeding trial. The kid fed on a balanced ration had a considerably higher carcase percentage (47.6) than the one fed on a *kampong* ration (41.1). Quality of the former was held to be superior though rather too fat.

Pigs.

The first replication of a trial to test the effect of "aurofac" on growth rates of pigs at Serdang neared completion. There was very little difference between the growth rates of "treated" and "untreated" groups, though the former looked rather more "finished". Food consumption data are not yet available.

Miscellaneous.

Soil Surveys.

Tanjong Minyak, Malacca.

At the request of the Drainage and Irrigation Department, a soil survey of the Tanjong Minyak irrigation area has been undertaken. This area includes the valleys of the Sungei Ayer Salak and the Sungei Ayer Hitam and covers between 1,500 and 2,000 acres. Some of the area is covered with standing gelam (*Melaleuca leucadendron*), and other areas are old gelam land. The area had been reported as being very sulphurous, and as a drainage scheme had been proposed some information on the nature of the soil is desirable.

As parts of the area are covered with gelam and other parts completely free of it, it was decided to do a very detailed survey as part of the study of gelam soils. The soil was examined at points on a grid 3 x 10 chains and auger borings to a depth of 6 ft. made at each of these points. Samples, representative of the various soil types, were taken for laboratory analyses.

Gelam is not found on the deep peat but attains its strongest growth on what looks, from a textural point of view, the best padi soil, i.e. the silty clays and clays. Some of the soils contain very considerable quantities of sulphur, up to 6 per cent. in places. The top 24 ins. of the soil is generally fairly low in sulphur (maximum 1 per cent.), but below 24 inches there is a rapid increase in sulphur content. The types of soils associated with the highest content of sulphur are generally clays and clay mucks.

Proposed Agricultural Station on Coastal Clay.

A visit was made to an area in the Telok Gadong Forest Reserve, Selangor, to examine a site for an Agricultural Station on coastal clay. The area was found to have a very high water table; this can be remedied once the area has been bunded. The soil had a very good friable texture, contained a fair amount of organic matter in the top horizons, and seemed to be of much better texture than the soil found, for example, at the former Port Swettenham station.

Laboratory Investigations.

Clay Fractions.

The clay fractions from a number of representative Malayan soils were separated and have been sent to the Macaulay Institute for Soil

Research, Aberdeen, for X-ray analyses. It is hoped that the analyses will give some information on the different types of clay minerals in Malayan soils and also help in interpreting the properties of some of these soils.

Polarographic Work.

The polarograph, after much trouble, was finally made to function and a start was made on the determination of copper and zinc in peat soils. A number of difficulties were encountered and rigid standardisation is necessary in order to get reproduceable results. Unfortunately, by the time the apparatus and method showed some promise, the contract of the officer doing the work finished and the investigation has been stopped temporarily.

Mites.

A sample of an acaricide called "Aramite", chemically 2-(p-tertiary-butylphenoxy) isopropyl 2-chloroethyl sulphite, has been received from America, and a preliminary, small-scale test has shown it to be promising. The species of mites used in these tests have not yet been identified.

Used at 0.03 per cent. actual toxicant in the spray, all mites on violets were killed in 24 hours, and their eggs failed to hatch. There were 4.2 per cent. and 3.3 per cent. deaths on the two control plants in the same period, and eggs hatched normally. In a second test with mites on the plant *Talinum triangulare* Willd. 93.8 per cent. and 95.2 per cent. of the mites were killed in three days. There was a 20 per cent. mortality among the controls during the same period.

Unlike some of the acaricides now being produced, "Aramite" appears to have a low mammalian toxicity, the LD_{50} for mice being 2.0 g./kg. and to rats and guinea pigs 3.9 g./kg.

NOTES ON EXTENSION WORK, APRIL TO JUNE, 1953.

Compiled by the Acting Chief Field Officer.

Padi.

Rice being the country's principal food, somewhat more than just passing interest is evinced in the crop, particularly at harvest time, by the general public.

Special mention is made of the 1952/53 season's rice crop, recently harvested. Contrasted with the previous season's crop, it is noted firstly, a larger acreage was planted, 785,610 acres as against 784,140 acres; secondly, the percentage acreage harvested was higher, 98.9 to 96.0; thirdly, the estimated yield per unit area was considerably greater, 351 gantangs (gallons) compared with 277 gantangs. All of which factors combine to make this season one of the best since the war.

Due to shortage of labour in certain areas, harvest time, for growers, is frequently a critical period, and so far no solution has yet been found to the problem of complete mechanical harvesting under Malayan conditions. It was successfully demonstrated last season, however, that in areas where the padi is normally harvested with the *tuai* and road communications are good, there is a place for small, mechanical threshers. In Selangor a proposal has, therefore, been made for a Rural and Industrial Development Authority scheme, utilizing two Turner Threshers, to operate during the next harvest at Tanjong Karang.

The co-operation of the Selangor Department of Agriculture in fostering the sale of unmixed samples of padi to the Government Rice Mill at Tanjong Karang was sought and given. This year, for the first time, a premium of $1 per picul is being awarded for unmixed padi of Radin, Acheh and Seraya strains delivered at the mill. The role required of the Department was to arbitrate in the case of disputes between the mill and the growers.

A system of off-season cropping, provided water control is possible and a short-term strain is used, is an obvious method of augmenting the annual output per unit area. It is a system commonly practised in parts of Province Wellesley and in the Yen district of Kedah. Recent investigations in Kelantan have proved the feasibility of off-season cropping in the Salor Irrigation Area, and a large-scale demonstration is currently being staged. The planted area covers approximately 100 acres and, much to the surprise of the local residents, it was possible to cultivate, mechanically of course, and to transplant in the limited time available without deviating in any way from the schedule. The latest progress report received described the growth of the padi as good.

In the northern States, Perlis, Kedah and Kelantan, comprising between them almost 60 per cent. of the total planted area of wet padi

land in Malaya, the weather has been favourable, permitting an early start to be made with the main crop cultivation.

The State Departments in both Kelantan and Kedah are conducting intensive "Extension" campaigns encouraging the use of recommended fertilisers in rice growing. In the former State, the campaign was first launched in 1952 and resulted in approximately 250 tons of the approved fertiliser mixture, enough for some 2,480 acres, being used. So excellent were the results obtained, with consequent stimulation of interest on the part of other planters, it is confidently expected that the amount of fertiliser used during the coming season will be increased tenfold. Valuable assistance is given by the Rural and Industrial Development Authority in distributing the mixture from central depots. One interesting development has been the widespread return to cultivation of hitherto uneconomic sub-marginal padi areas.

The culmination of several years investigations in Kedah relating to economic padi manuring is seen in the recommendation, with particular reference to the light and medium texture soils, of which there are approximately 190,000 acres, to use the combination of a pre-cultivation dressing of phosphate and a post-planting application—eight weeks after transplanting—of ammonium sulphate. The widest possible publicity is being given to the Kedah campaign and to-date 75,000 pictorial leaflets depicting the technique of application and manures to be used have been distributed.

Great importance is attached not only to the type of fertiliser used but also to the method of application, and arrangements have been completed, in both Kelantan and Kedah, for several hundred demonstration plots to be manured, during the coming season, according to recommended practice. These plots have been purposely selected so as to give as wide a scatter as possible. They will also be used to demonstrate correct nursery technique and optimum spacing, for it has been proved, experimentally, that the use of overage seedlings and incorrect spacing seriously diminish yields.

Post-war selection of padi seed is most advanced in Malacca, and from the twenty-nine seed farms planted last season a total of 10,500 gantangs of first quality seed was obtained. Farmers are eager to obtain this seed, for comparisons between selected and unselected local strains have consistently shown a balance in favour of the former varying from 12 to 23 per cent.

Demonstrations of mechanical cultivation of *bendang* * staged in Perak and Pahang, have evoked keen interest on the part of local farmers.

Organised pest destruction, directed principally against rats, was undertaken in Kedah, Perlis and Malacca.

Rubber.

The Rubber Replanting Scheme aims to replant 50,000 acres in 1953, and up to a total of 500,000 acres by the end of 1959, and the no

* *Bendang* = a padi field.

mean task of providing the approved planting material is the responsibility accepted by the Department. This work has been decentralised to State level, and State and Settlement Agricultural Officers are currently engaged on extending budwood nurseries and preparing nurseries to receive clonal seed from the anticipated seedfall in July and August. For the Replanting Scheme to be a success the closest co-operation must exist between the various Departments concerned, and the excellent progress made to-date is a tribute to the prevailing spirit of liaison between the officers of the Rubber Research Institute, the Replanting Scheme, and the Department of Agriculture. The responsibility of State and Settlement Agricultural Officers does not end, however, with simply growing approved planting material; much is still expected from them in the way of propaganda, publicity, advice, etc. All of them are also to be found as active members of their respective State Replanting Advisory Committees.

During the quarter, approved planting material comprising 14,927 yards of budwood, 154,934 clonal seedling stumps (mostly from Rubber Research Institute sources) and 93,820 germinated clonal seed were distributed by the Department.

Rubber Smallholders' Associations have been formed in various parts of the country and, by virtue of the ready co-operation given to Departmental officers, play a most important part in "Extension".

The marketing of smallholders' latex, as latex, is encouraged and schemes operate in most States for its collection and processing in bulk.

Fruit.

Budded fruit planting material, largely of rambutans and durians, distributed from Agricultural Stations amounted to 6,068 plants. A total of 2,640 miscellaneous seedling fruits was also sold or given away free to local farmers or to New Villages.

Cacao.

Small Amelonado seed gardens are in course of being established in one or more selected areas in every State. To-date, precise data of the total area so far planted are not available but enough planting material for an estimated 55 acres has been distributed by the Senior Botanist to State and Settlement Agricultural Officers.

Coconuts.

Rhinoceros beetles (*Oryctes Rhinoceros*) appeared to be more prevalent than usual in the coastal districts of Selangor. Warnings were issued to one saw-mill, four estates and two *kampongs* that unless steps were taken to eliminate potential breeding grounds, action would be taken under the Pests Enactment.

Livestock.

Pigs.

The Agricultural Station at Tanah Rata, Cameron Highlands, continued to function as a bulking centre for pure-bred Middle White pigs.

During the quarter 95 weaner pigs, 42 boars and 53 gilts were sold from this centre to breeders, the majority of whom resided in New Villages. In addition, 15 weaner boars and 28 gilts were distributed from Departmental centres on the plains. The establishment and maintenance of stud centres in all pig rearing areas was a continued policy.

Poultry.

The extension policy of the Department may be briefly stated as "to take the necessary steps to meet the public demand, where it exists, for pure-bred birds", and in its pursuance a total of 1,166 pure-bred birds of all ages and 2,117 eggs for hatching were distributed. Besides managing a hatchery for the intensive production of two months-old, pure-bred chicks, the State Agricultural Officer, Selangor, also meets public demand by importing day-old chicks by air from England.

Fish.

With the improvement in the security position, almost all the abandoned ponds in Kuala Lumpur district have now been restocked, some with carp and others with *Tilapia mossambica.* Fry of the latter were obtained from the experimental pond at Sungei Buloh Agricultural Station.

New Villages.

In Perak, Selangor and Negri Sembilan, 16 Departmental tractors were employed on dry-land cultivation of food crop areas attached to New Villages.

Agricultural schemes designed to improve and extend the agriculture associated with New Villages were financed, from the funds administered by the Member for Agriculture and Forestry for that purpose, to the order of $142,500. All States, with the exception of Kelantan and Trengganu, participated and the various schemes included the establishment of Agricultural Demonstration Stations, the construction and stocking of piggeries, digging of experimental fish ponds, fencing, and improvements to drainage of vegetable and food crop areas.

Agricultural Education.

There is no limit to the scope afforded for agricultural education in Malaya for which, in all its forms, there is a steadily growing clamour. The general lines followed in all States to meet this growing demand have been to provide Field Days at Agricultural and Padi Stations, to participate in Civics Courses, and to stage demonstrations and lecture to Women's Institutes, schools, Smallholders Associations, penghulus and so on. In two States, Kedah and Selangor, facilities have been provided for long and short term courses on general or specialised agriculture at the main Agricultural Station in those States. In addition, day courses on mechanisation and budgrafting were held frequently at Telok Datoh

Agricultural Station for the inmates of the nearby Morib Rehabilitation Centre.

General.

The April issue of the Kedah Agricultural Newsletter, *Perkhabaran Tanaman*, was devoted exclusively to padi planting and manuring. It has a circulation of 6,000 copies.

At the Malayan Agri-Horticultural Association Show in April, and the Kuala Pilah Agricultural Show in May, the respective State Agricultural Departments were responsible for staging the special agricultural exhibit stall.

Padi Shows, organized at mukim, district and State level by the Department, were completed in Kedah in May. The winning exhibits have been retained and will be entered for the Pan-Malayan Padi Show to be held under the auspices of the Malayan Agri-Horticultural Association later in the year.

Review

JUTE SUBSTITUTE FIBRES

By A. E. Haarer, F.L.S. Wheatland Journals Ltd., London, 1952.

Pp. XXI + 185. Price 30 shillings.

Ecological requirements determine close regional limits of cultivation of many fibre plants, particularly the true jute *Corchorus* spp., and many attempts have recently been made to widen the range of production of suitable substitute fibres of this type.

In the publication under review, Mr. Haarer has presented a most useful critical survey of present information on three of the best of these jute substitutes, namely—Bimlipatam jute and Roselle (*Hibiscus* spp.), grown as annuals, and Aramina or Urena fibre (*Urena lobata*), grown as a perennial in the tropics.

All aspects of the cultivation and preparation of these fibres are very fully dealt with, including botanical descriptions, fibre evaluations, selection and breeding, climatic and agricultural requirements, diseases and pests, harvesting, and processing. Matters of particular interest noted included field defoliation by chemicals, mechanical harvesting, and mechanical field decortication. The photoperiodicity reactions of *Hibiscus cannabinus* are discussed.

The book is very well illustrated with photographs, drawings and analytical and other tables.

The fibre plant species under reference are adapted to drier soil conditions than is the true jute, *Corchorus capsularis*, and the cultivation of such annuals as field crops in the wet tropical climate of Malaya cannot be advised, although promising trials are in progress here with *Corchorus*.

For anyone interested in any fibre crops, however, this publication, by Mr. Haarer, can be cordially recommended as a very well considered and authoritative work of reference.

R.B.J.

Departmental Notes

We regret to have to record the deaths of Mr. Khoo Teik Ee, C.B.E., and Che. Mahmud bin Haji Osman.

Mr. Khoo was president of the Malayan Estate Owners' Association and as such was a member of the Advisory Council of the College of Agriculture. He served as a member of the Council from 1947, and his interest, judgement and support in matters affecting the College will be greatly missed at future meetings.

Che. Mahmud, who was an Agricultural Assistant in Kedah, died in the General Hospital, Alor Star, on the 28th June, 1953, as a result of illness. He joined the Service in 1928 and served in several Districts throughout Kedah; he was Agricultural Assistant, Padang Terang, at the time of his death at the age of 45.

Promotion.

The Right Honourable the Secretary of State for the Colonies has approved the promotion of Mr. R. B. Jagoe, Senior Botanist, to be Chief Research Officer with effect from the 14th October, 1952.

Appointments.

The following appointments have been made:—

Mr. R. J. A. W. Lever, Entomologist, acted as Senior Entomologist from the 11th April until the 3rd June, 1953.

Mr. J. R. Curry, Chief Field Officer, to act as Deputy Director of Agriculture with effect from the 13th April, 1953.

Mr. J. Cook, Senior Agricultural Officer, to act as Chief Field Officer with effect from the 13th April, 1953.

Mr. P. G. Coleman, Agricultural Officer, to act as State Agricultural Officer, Kedah and Perlis, with effect from the 13th April, 1953.

Mr. R. Henderson, M.C., Agricultural Officer, to act as Senior Agronomist with effect from the 20th April, 1953.

Mr. H. D. Matheson, Agricultural Officer, to be Agronomist, Malacca, from the 29th April, 1953, and Settlement Agricultural Officer, Malacca, from the 14th May, 1953.

Mr. J. K. Coulter, Acting Senior Chemist (Soils), to act as Senior Chemist in addition to his other duties with effect from the 7th May, 1953.

Mr. A. L. Barcroft, Agricultural Officer, to be Agronomist-in-Charge, Federal Experiment Station, Serdang, with effect from the 3rd June, 1953.

Mr. H. M. James, M.C., Agricultural Officer, to act as Principal, College of Agriculture, Malaya, with effect from the 15th June, 1953.

Mr. J. S. Ure, Agricultural Officer, to be Senior Lecturer, College of Agriculture, Malaya, with effect from the 4th July, 1953.

Transfer.

Mr. J. L. B. Hitchcock, Agricultural Officer, was transferred from the Federal Experiment Station, Serdang, to the post of Agricultural Officer, Kedah, on the 7th April, 1953.

Leave.

The following officers have returned from leave:—

Mr. H. Ritchings, Horticultural Officer, on the 31st March, 1953.
Mr. H. D. Matheson, Agricultural Officer, on the 27th April, 1953.
Mr. D. W. M. Haynes, Agricultural Engineer, on the 27th May, 1953.
Mr. H. T. Pagden, Senior Entomologist, on the 3rd June, 1953.
Mr. A. L. Barcroft, Agricultural Officer, on the 3rd June, 1953.
Mr. R. B. Jagoe, Chief Research Officer, on the 30th June, 1953.

The following officers proceeded on leave during the quarter:—

Mr. E. W. Bewlay, Agricultural Development Officer, on the 7th April, 1953.
Mr. H. T. Pagden, Senior Entomologist, on the 12th April, 1953.
Mr. R. G. Heath, Deputy Director of Agriculture, on the 13th April, 1953.
Mr. E. F. Allen, Senior Agronomist, on the 20th April, 1953.
Mr. Gunn Lay Teik, Senior Chemist, on the 7th May, 1953.
Mr. J. Chattaway, Agricultural Officer, on the 14th May, 1953.
Mr. R. J. A. W. Lever, Entomologist, on the 11th June, 1953.
Mr. A. E. Billington, Canning Officer, on the 10th June, 1953.
Mr. O. M. Lee, Principal, College of Agriculture, Malaya, on the 14th June, 1953.
Mr. L. N. H. Larter, Botanist, on the 6th July, 1953.

MARKET PRICES

April to June, 1953.

Rubber.—The price of this commodity continued its decline during the second quarter, the average Singapore prices for No. 1 R.S.S., f.o.b., in bales, for the three months being: April, 68.66; May, 71.56; and June, 67.51 cents per lb.

On the first day of the new quarter the price dropped by 7/8 cent per lb. to 68 1/4 cents, and reached its lowest figure since April, 1950, 65 3/8 cents, on the 8th April. A gradual increase brought the price to 76 3/8 cents by the 5th May but it dropped back to 69 3/4 cents by the end that month. During June the price was at its highest, 69 3/8 cents, on the first day, and reached a new low level of 64 7/8 cents on the 30th of the month.

The average prices paid for smallholders' rubber at three towns in the Federation of Malaya during the period under review are given in Table I.

Table I.

Average Monthly Prices Paid by Local Dealers for Smallholders' Rubber, April to June, 1953.

(Dollars per picul of 133 1/3 lbs.)

Grades.	Taiping, Perak.			Seremban, Negri Sembilan.			Batu Pahat, Johore.		
	April	May	June	April	May	June	April	May	June
Smoked Sheet	75.38	78.29	73.85	75.35	79.62	74.40	76.02	79.52	73.98
Unsmoked Sheet	64.68	67.24	64.65	53.28	54.52	49.29	61.87	64.30	61.45
Scrap	40.73	42.65	41.27	38.08	40.57	38.52	28.19	26.75	25.96

This Table has been compiled from statistics supplied by the Registrar of Statistics, Federation of Malaya.

Tea.—There were no public sales of Malayan tea in Colombo during the period under review. The average prices of Ceylon teas at the sale held in Colombo on the 29th June, 1953, as quoted in the Weekly Report of the Colombo Brokers' Association, were, in rupees per lb.: High Grown Teas 1.96, Medium Grown Teas 1.79, Low Grown Teas 1.90.

In a return published by the Acting Registrar of Statistics, Federation of Malaya, production of made tea in the Federation, as declared by estates, during the second quarter of 1953 was 51,971 lbs. green and 1,057,572 lbs. black teas.

The retail price of Malayan tea (Boh) has remained at $2.60 per lb.

Derris.—The price of derris, in dollars per picul, as quoted in the weekly reports of the Singapore Chamber of Commerce, ranged from 140 to 145 in April, 135 to 145 in May, and 120 to 140 in June.

Rice.—The ration is 3½ katis * of Government imported and 1½ katis of commercially imported rice per week. The retail prices of rice are, in cents per kati: High Grade 35 to 41, Medium Grade 27 to 33, and Low Grade 19 to 21.

Table II.

Singapore Prices of Various Agricultural Products.

(Dollars per picul)

Date	Copra, Sundried	Coconut oil*	Pepper. F.A.Q. Muntok white	Pepper. Gen. Muntok white	Gambier, Cube	Sago Flour, Lingga	Tapioca Flour No. 1	Oilcake, Round
1953								
7th April -	41.50	64.50	610.00	620.00	78.00	16.00	26.50	20.00
13th April -	42.50	65.50	590.00	600.00	78.00	15.75	26.00	20.00
20th April -	42.50	63.00	590.00	600.00	78.00	16.00	26.00	20.00
27th April -	39.00	62.50	565.00	570.00	75.00	16.00	25.00	20.00
4th May -	38.00	60.00	555.00	565.00	76.00	16.50	24.00	19.00
11th May -	38.00	60.00	560.00	570.00	75.00	16.50	24.00	20.00
18th May -	37.75	60.50	570.00	580.00	75.00	16.25	23.75	19.00
26th May -	38.25	62.00	565.00	575.00	75.00	16.25	23.50	19.00
8th June -	37.75	60.00	550.00	560.00	75.00	15.75	23.25	19.00
15th June -	33.50	57.50	540.00	550.00	75.00	15.50	22.50	19.00
22nd June -	32.00	53.00	530.00	540.00	74.00	15.25	22.50	18.00
29th June -	30.50	51.50	480.00	490 00	74.00	15.00	22.50	18.50

* F.O.B.

The above prices are taken from the weekly reports of the Singapore Chamber of Commerce.

* 1 kati = 1⅓ lbs.

FEDERATION OF MALAYA
PRODUCTION OF PALM OIL AND KERNELS.

(In long tons as declared by Estates)

Month	Palm Oil		Palm Kernels	
	1952	1953	1952	1953
January	3,182	3,946	839	1,008
February	3,110	3,611	850	923
March	3,327	3,778	865	1,031
April	3,350	4,061	893	1,066
May	3,076	4,209	793	1,076
June	3,020	4,122	718	1,056
July	3,988		959	
August	3,819		931	
September	4,044		983	
October	4,265		1,066	
November	4,797		1,176	
December	5,117		1,175	
Total	45,095	(23,727)	11,248	(6,160)

In June, 47 estates (planted area 97,778 acres) were in production out of a total of 53 oil palm estates (planted area 101,041 acres).

MALAYAN AGRICULTURAL EXPORTS, JANUARY-MARCH, 1953.

Product	Net Exports in Tons.			
	Year 1951	Year 1952	Jan.-Mar., 1952	Jan.-Mar., 1953
Arecanuts	13,547	10,467	5,010	3,466
Coconuts, fresh †‡	32,540 †	94,024 †	16,186 †	13,595 †
Coconut oil ‡	68,139	65,113	13,222	9,398
Copra ‡	10,878 *	27,821 *	5,319 *	650 *
Copra cake	37,891 *	60,287 *	12,830 *	14,926 *
Gambier, all kinds	36	94 *	12	—
Palm Kernels	11,809	10,869	3,069	2,839
Palm Oil	45,022	46,008	12,343	9,993
Pineapples, canned	16,859	11,762	2,047	3,980
Rubber ¶	603,880 ¶	582,646 ¶	140,510 ¶	141,211 ¶
Sago,—flour	28,044	19,146	2,739	5,819
„ —pearl	3,401	5,553	1,646	1,609
„ —raw	27,603 *	24,835 *	6,568 *	6,664 *
Tapioca,—flake	462	39 *	22 *	1 *
„ —flour	4,475 *	4,075 *	1,077 *	1,253 *
„ —pearl	10,230	6,304	2,138	1,551
Derris	56	13 *	20 *	7
‡ Copra equivalent	100,499	79,868	16,491	17,341

¶ production (Federation of Malaya). † hundreds in number. * net imports.

FEDERATION OF MALAYA RUBBER PRODUCTION.

(In long tons, dry weight)

Month	Estates		Smallholdings (Estimated)		Total	
	1952	1953	1952	1953	1952	1953
January	27,044	31,354	23,770	23,514	50,814	54,868
February	24,007	23,423	19,200	19,140	43,207	42,563
March	25,679	26,898	20,810	16,882	46,489	43,780
April	25,533	26,155	19,065	16,805	44,598	42,960
May	27,362	27,820	18,346	17,679	45,708	45,499
June	27,243	27,202	20,333	17,024	47,576	44,226
July	29,473		20,299		49,772	
August	28,301		22,052		50,353	
September	28,690		20,005		48,695	
October	29,369		18,856		48,225	
November	31,827		18,855		50,682	
December	33,800		22,727		56,527	
Total	338,921 *	(162,852)	244,318	(111,044)	583,239 *	(273,896)
Total 1951	327,956		275,924		603,880	

This Table has been compiled from statistics published by the Registrar of Statistics, Federation of Malaya.

Smallholding production is estimated from purchases reported by dealers.

* These figures include an adjustment of 593 tons. The monthly production figures have not been altered.

FEDERATION OF MALAYA
PRODUCTION OF COPRA, COCONUT OIL AND COPRA CAKE.

(in tons)

Month	Copra Production						Coconut Oil Production		Copra Cake (Poonac) Manufactured	
	Estates		Smallholdings (estimated)		Total		Oil Mills		Oil Mills	
	1952	1953	1952	1953	1952	1953	1952	1953	1952	1953
January	2,740	2,555	9,296	8,241	12,036	10,796	6,681	5,597	4,244	3,594
February	2,777	2,405	8,510	6,092	11,287	8,497	6,338	4,236	4,016	2,694
March	2,864	2,793	8,522	6,703	11,386	9,496	5,616	4,800	3,647	2,981
April	2,964	2,753	8,684	7,972	11,648	10,725	6,128	5,294	3,949	3,379
May	3,279	3,306	8,560	8,744	11,839	12,050	5,797	5,660	3,820	3,633
June	3,643	3,357	7,642	9,842	11,285	13,199	6,067	6,478	3,960	4,078
July	3,846		11,294		15,140		7,177		4,075	
August	4,151		10,357		14,508		7,645		4,902	
September	3,848		12,426		16,274		8,292		5,014	
October	3,358		10,757		14,115		7,622		4,981	
November	3,103		9,569		12,672		7,214		4,695	
December	2,950		9,225		12,175		6,608		4,278	
Total	39,523	(17,169)	114,842	(47,594)	154,365	(64,763)	81,185	(32,065)	51,581	(26,359)

Notes:—1. The above statistics are compiled and published by the Registrar of Statistics, Federation of Malaya.

2. Estate copra production and coconut oil production are as declared by estates and oil mills respectively.

3. Statistics of smallholding coconut oil production are not available.

4. Smallholding copra production for commercial purposes is estimated from the formula: imports + estate stocks (opening) + estate production + smallholding production = exports + local oil mill consumption + estate stocks (closing).

METEOROLOGICAL SUMMARY, MALAYA, APRIL, 1953.

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes									Number of days							
	A. Max.	B Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F	Total		Most in a day Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										ins.	mm.	ins.						hrs.	hrs.	
Ipoh, Perak	92.0	73.4	82.7	96.4	71.8	88.7	75.2			24.81	630.2	2.70	20	19	9		1	222.60	7.42	
Port Swettenham, Selangor	89.7	73.4	81.5	93.6	71.2	86.8	75.3	85.6	85.2	8.38	212.9	1.26	22	17	5	1		201.45	6.71	
Kuala Lumpur, Selangor	91.2	74.2	82.7	93.2	71.8	86.4	77.4			15.67	398.0	2.43	24	21	13	6				
Sitiawan, Perak	89.3	74.2	81.7	91.4	71.6	86.0	76.2	85.9	86.3	7.80	198.1	1.69	18	15	9	1		233.45	7.78	
Kuala Lipis, Pahang	91.2	72.3	81.7	94.0	69.9	87.0	73.9	84.3	85.1	8.74	222.0	2.28	18	14	3	29		190.60	6.35	
Kuantan, Pahang	89.3	71.9	80.6	92.2	69.2	85.0	74.4			11.78	299.2	3.64	20	15	4	9		195.05	6.50	
Temerloh, Pahang	91.1	74.7	82.9	93.5	71.9	85.6	76.3			7.86	199.6	2.03	19	16	9	9		194.05	6.47	
Bayan Lepas, Penang	88.8	75.2	82.0	90.9	72.4	86.0	77.0			6.13	155.7	1.49	24	20	4			234.00	7.80	
Malacca	86.8	74.2	80.5	91.8	72.0	82.5	76.0			4.76	120.9	1.89	17	13	4	1	3	225.80	7.53	
Mersing, Johore	87.8	72.9	80.3	91.9	71.2	85.1	74.9			5.97	151.6	2.69	9	7	1			238.80	7.96	
Alor Star, Kedah	91.6	74.1	82.9	95.4	71.4	88.7	77.2			14.76	374.9	2.31	20	20	6		1	246.60	8.22	
Kota Bharu, Kelantan	90.3	74.7	82.5	92.8	72.1	88.5	78.0	88.0		3.01	76.5	0.75	12	10	1			268.40	8.95	
K. Trengganu, Trengganu	88.5	73.7	81.0	90.6	71.3	84.0	75.3			3.44	87.4	0.86	13	10		1		261.25	8.71	
Kallang Aerodrome (S'pore)	88.5	75.7	82.1	92.6	73.4	82.4	79.0			9.88	251.0	2.52	17	16	8		1	186.95	6.23	
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	74.3	63.5	68.9	78.6	62.1	71.5	65.2	73.4	73.1	12.05	306.1	1.40	23	20	7	17		146.80	4.89	
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	—	57.1	—	—	51.0	—	62.0			14.05	356.9	2.57	20					151.40	5.05	

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, MAY, 1953.

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes						Total		Most in a day	Number of days					Total	Daily Mean	Per cent.
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F			Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
										ins.	m m.	ins.						hrs.	hrs.	
Ipoh, Perak	92.1	73.3	82.7	94.6	69.0	87.8	75.2			7.56	192.0	2.14	16	15	3			231.25	7.46	
Port Swettenham, Selangor	89.9	73.3	81.6	93.6	71.6	85.0	76.0	86.3	85.7	3.64	92.5	1.38	15	11	3			203.00	6.55	
Kuala Lumpur, Selangor	90.7	74.1	82.4	94.6	71.5	85.8	76.0			7.43	188.7	1.92	17	13	6	6				
Sitiawan, Perak	89.7	73.7	81.7	92.5	70.8	82.5	75.8	86.1	86.7	7.15	181.6	2.54	12	9	3			220.35	7.11	
Kuala Lipis, Pahang	89.8	72.4	81.1	93.0	69.9	85.3	75.0	84.2	85.1	5.38	136.7	1.05	18	18	2	28		196.15	6.33	
Kuantan, Pahang	89.1	72.5	80.8	92.2	69.9	80.3	75.7			11.75	298.5	2.49	19	17	6	12		199.15	6.42	
Temerloh, Pahang	89.8	74.0	81.9	92.5	70.6	84.4	75.9			14.05	356.9	5.12	13	12	7	5		205.00	6.61	
Bayan Lepas, Penang	88.2	75.4	81.8	91.0	72.0	83.5	78.5			13.80	350.5	3.17	16	15	7			206.90	6.67	
Malacca	86.2	74.1	80.1	88.7	72.0	82.4	75.9			4.80	121.9	1.74	15	10	3			215.00	6.93	
Mersing, Johore	87.6	72.5	80.1	90.1	71.1	81.0	75.1			5.31	134.9	1.34	18	16	4	1	1	203.05	6.55	
Alor Star, Kedah	89.2	75.2	82.2	92.7	73.2	83.4	77.2			5.52	140.2	1.46	13	10				214.55	6.92	
Kota Bharu, Kelantan	90.1	74.2	82.1	92.5	71.5	85.0	76.7	87.8		6.65	168.9	2.67	17	14	5	1		242.95	7.84	
K. Trengganu, Trengganu	88.8	73.8	81.3	90.8	71.6	80.5	76.4			4.15	105.4	1.88	10	8	2			228.60	7.37	
Singapore	87.6	75.9	81.7	90.8	72.8	82.9	78.3			3.75	95.3	0.77	16	13	6		1	181.45	5.85	
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	74.8	63.7	69.3	77.4	60.9	70.3	65.5	74.3	73.9	8.51	216.2	2.39	24	19	9	18		180.60	5.83	
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	—	56.9	—	—	52.0	—	62.0			8.11	206.0	2.05	13					169.25	5.46	

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, JUNE, 1953.

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes									Number of days							
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F	Total		Most in a day Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										ins.	m.m.	ins.						hr.	hr.	
Ipoh, Perak	91.9	73.2	82.5	95.2	70.2	85.2	78.2			5.09	129.3	1.22	12	10	3		2	228.65	7.62	
Port Swettenham, Selangor	89.9	73.3	81.6	93.0	70.4	83.0	75.8	85.6	85.5	7.59	192.8	1.99	13	12	4			198.00	6.60	
Kuala Lumpur, Selangor	91.0	73.9	82.5	94.1	72.0	86.0	76.2			5.24	133.1	1.25	14	13	6	3				
Sitiawan, Perak	89.4	74.0	81.7	92.2	70.2	84.8	76.5	85.8	86.4	7.21	183.1	2.46	11	9	5			215.00	7.17	
Kuala Lipis, Pahang	89.9	72.8	81.3	94.0	69.9	85.0	76.0	84.7	85.3	4.72	119.9	1.40	9	8	1	27		193.00	6.43	
Kuantan, Pahang	89.5	72.9	81.2	92.2	69.4	83.4	76.8			7.92	201.2	3.04	13	11	5	7		213.20	7.11	
Temerloh, Pahang	90.1	74.4	82.3	92.5	70.2	85.7	77.1			3.26	82.8	1.23	7	7	3	12		208.65	6.95	
Bayan Lepas, Penang	88.7	75.5	82.1	91.3	72.9	84.6	79.2			3.09	78.5	1.02	11	6	4			197.25	6.57	
Malacca	86.4	74.4	80.4	87.8	71.1	85.0	76.8			6.25	158.8	1.42	14	11	4		3	232.40	7.75	
Mersing, Johore	88.4	73.0	80.7	90.5	70.2	86.1	77.0			5.07	128.8	1.22	11	10	1		2	224.20	7.47	
Alor Star, Kedah	89.6	75.1	82.3	92.7	72.6	83.6	76.8			8.24	209.3	3.43	13	11				199.25	6.64	
Kota Bharu, Kelantan	89.7	75.4	82.5	92.2	70.9	85.0	77.9	87.6		3.15	80.0	1.77	7	5	2			209.85	6.99	
K. Trengganu, Trengganu	89.5	73.9	81.7	92.4	70.3	85.2	77.2			4.40	111.8	1.71	7	5	2			221.10	7.37	
Singapore	88.7	77.8	83.3	90.8	73.0	84.2	82.5			4.24	107.7	0.92	15	13	4			206.70	6.89	
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	74.3	63.6	68.9	77.6	60.2	69.8	65.0	73.7	73.9	6.19	157.2	1.48	14	12	5	11	2	166.75	5.56	
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	74.5	56.5	65.5	77.0	51.0	69.0	62.0			8.14	206.8	2.05	13					179.95	6.00	

Compiled from Returns supplied by the Malayan Meteorological Service.